THE SELECTION AND TRAINING OF ACTIVE ELDERLY AS SENSORY EVALUATION PANELISTS

BY

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Format of Thesis

This thesis follows the format of the _Thesis Writing Manual_ of the Oklahoma State Univesity Graduate College except for Chapter III and IV. Chapter III is written and referenced following the format and citation form of the _Sociological Spectrum_. Chapter IV is written following the guidelines for the journal, _Poultry Science_.
The thesis Bibliography follows the example of specimen bibliograph Form A given in the _Thesis Writing Manual_.

CHAPTER I

INTRODUCTION

The current concern about the diet and nutrition of elderly people has encouraged research in aging, including age-related taste preference research. This recognition makes the absence of the older adult from taste panel studies surprising, particularily since it is widely assumed taste perceptions diminish markedly with age.

Sensory evaluation used in product development and testing has progressed to an analytical science providing information critical to the success of a new or improved food product. Sensory evaluation plays a vital role in research and development of a new product and, when used as a scientific tool, a friendly companion, not a replacement for marketing research.

When a new product is considered for the elderly, the members of the targeted population are rarely actively involved in the development phase. The emphasis of this research is the use, in product development, of a sensory evaluation panel composed of persons over 60 years old.

PURPOSE

The purpose of this research was to study the taste acuity of a sample of local non-institutionalized elderly persons and relate this to the effectiveness of training them as sensory evaluation panelists. This study sought to identify both the detection and identification thresholds of the sample group (60+), and compare these thresholds to those of two other adult groups: 20-39 and 40-59 years.

OBJECTIVES

Specific objectives were as follows:

1 a. To establish detection and identification thresholds for the sample elderly group and compare to two other adult age groups: 20-39 years, 40-59 years;

b. To test whether differences exist in the ability to detect and identify flavors and odors among the elderly compared to other adult groups;

2. To compare the threshold levels of all three age groups to published non-age specific thresholds;

3. To evaluate the elderly panelist reproducibility of results when trained for sensory evaluation by comparison with a mixed-aged panel.

HYPOTHESIS

H1: There is no significant differences in the elderly panelists ability to detect and identify flavors and odors compared to the other adult age groups.

H2: There is no significant differences between the threshold levels established by the three age groups and the published non-age specific thresholds levels.

H3: There is no significant difference in the sensory judgements of individual elderly panelists and other panels, trained for sensory evaluation.

ASSUMPTIONS

1. Sensory evaluations are useful in the process of product development or product improvement in a controlled study.
2. Two sensory panels, differing in ages, will follow the same pre-testing guidelines identified by the researcher.
3. New pre-testing procedures are effective in detecting trainable taste abilities in both panel groups.
4. Training is beneficial in the sensory evaluation process.
5. The panel selection process is valid and reliable.
6. The design procedures are correct for the sample selection and research.

LIMITATIONS

1. The time and resources for research are limited.
2. The testing conditions will adequately control the variables that influence panelists responses.

DEFINITIONS

Acuity: The keenness of ability to detect and discriminate.

Adaptation, sensory: An increase or decrease in sensitivity to a given stimulus which occurs as a result of exposureto the stimulus.

ASTM: American Society for Testing and Materials--a Society that develops standards that meet the approval requirements of ASTM procedures and regulations.

Attitude: An aquired predisposition to respond in a consistent way toward a given class of objects or ideas.

Attribute: A perceived characteristic.

Descriptive analysis: A method for determining sensory characteristics of physical stimuli in which individuals either give descriptions of stimuli using the subject's own vocabulary and/or judge their intensity on predetermined properties.

Discrimination: The act of differentiating, qualitatively and quantitatively, between stimuli.

Flavor: The total of the sensations perceived by means of the taste buds, olfactory organ, and the buccal cavity which may include pain, temperature, and tactile sensations.

Qualitative Descriptive Analysis: A test method used in developing the sensory components of appearance, aroma, flavor, and texture of a product or sample.

Gustation: The sense of taste.

IFT: Self established acronym for Institute of Food Technologist.

Intensity: The perceived magnitude of a stimulus. odor- the sensations perceived by means of the olfactory organ in smelling certain volatile substances.

Paired comparison: A method in which stimuli are presented in pairs for comparison on the basis of some defined criterion.

Organoleptic: Absolete term relating to a property of a sample perceived by the sense organs.

Perception: The awareness of the effects of stimuli.

Preference: Liking for one object relative to one or several others.

Ranking: A method in which a series of three or more samples are presented at the same time and arranged in order of intensity or degree of some designated attribute.

Recognition threshold: The lowest physical intensity at which a stimulus is correctly identified a specific percent of the time.

Reference sample: A sample designated as the one to which all others are to be compared.

Sensory: Pertaining to the sense organs.

Sensory panel: A group of individuals that may be selected on the basis of sensitivity to stimuli, reliability, or whose perceptions are judged to be representative of some larger population. It is used to obtain information concerning the sensory attributes of physical stimuli.

Taste: Those sensations mediated by the taste buds.

CHAPTER II

REVIEW OF LITERATURE

The intent of this chapter is to give a brief history of sensory evaluation, establish a basic understanding of the sense of taste, review taste thresholds and perceptions, and examine current theories concerning taste perception in the elderly. Also covered are sensory evaluation procedures and methods.

History of Sensory Evaluation

Sensory evaluation has evolved into a whole new science. Sensory evaluation techniques have long been in use in quality control of products such as perfumes, essential oils and flavorings, coffee, tea, beer, wine, and distilled spirits. These evaluations were usually the opinions of one or two experts with many years of experience in evaluating the quality of a specific commodity. Growth in the food industry brought the realization that there were not enough experts to cover all of the new products being marketed. In addition, the experts' opinions did not necessarily reflect consumer attitudes (Pangborn, 1964). But, consumer attitudes are very important. This is illustrated by an excert from a

1931 paper by Platt who quoted a baking corporation vice-president:

> We must never forget that all of our millions of dollars worth of business depends upon that little sensation which our products make upon the tongues of our customers.

Platt also suggested that sensory evaluation judges be selected on their ability to predict public preference. Sweetman (1931), stated that the scientific study of food palatability consisted of measuring the intensities according to preference. Interest in `flavor in foods' was reflected in 1937, when 10 papers related to flavor were presented at an American Chemical Society Symposium. One paper on the selection of judges in measuring the sensory qualities of food attempted to separate `difference' testing from `preference' testing (King, 1937).

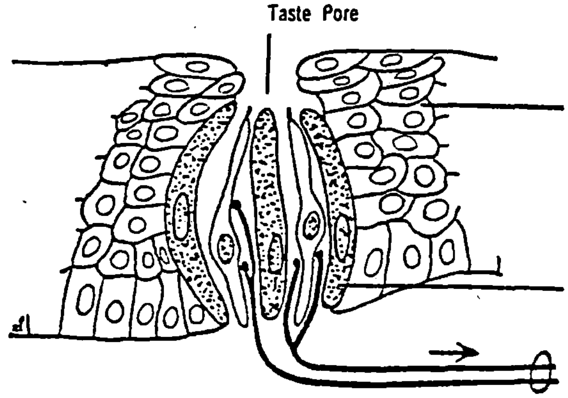
Investigators increasingly recognized the importance of careful selection and training of sensory evaluation judges and the importance of their evaluations on new product success. Gradually these two concepts emerged: Using laboratory (in-house) judges to evaluate the influences of processing variables on individual sensory properties of foods independent of preference; and correlating sensory parameters with physical and chemical properties of food (Pangborn, 1964).

The Sense of Taste

Taste--A Pychophysical sense

To a great extent modern day sensory analysis and product testing owe their scientific underpinnings to the branch of psychology known as psychophysics (Moskowitz, 1983). Psychophysics relates sensory perceptions to physical stimuli (Moskowitz, 1983). Psychophysics traditionally acts as a resource discipline for product testing, providing proven techniques to quantify human reactions.

Psychophysical studies of human taste have focused on the four `basic' tastes of sweet, sour, salty, and bitter (Cowart, 1981). While some researchers feel four basic tastes are insufficient in describing taste qualities, the four-taste system has proven extremely useful in the organization of psychophysical data (McBurney,and Gent, 1979). McBurney defines taste as those sensations mediated by the taste buds. (Figure 1) As such, the sense of taste is part of a perceptual system that involves all of the chemically sensitive nerves and end organs of the oral and nasal cavities that aid in the investigation of the chemical environment (Gibson, 1966). Flavor, on the other hand, is a broader term representing a composite of sensations derived from olfaction, touch, temperature, and vision. The distinction between taste and flavor is crucial to the understanding of the four basic taste qualities (McBurney, et al, 1979).

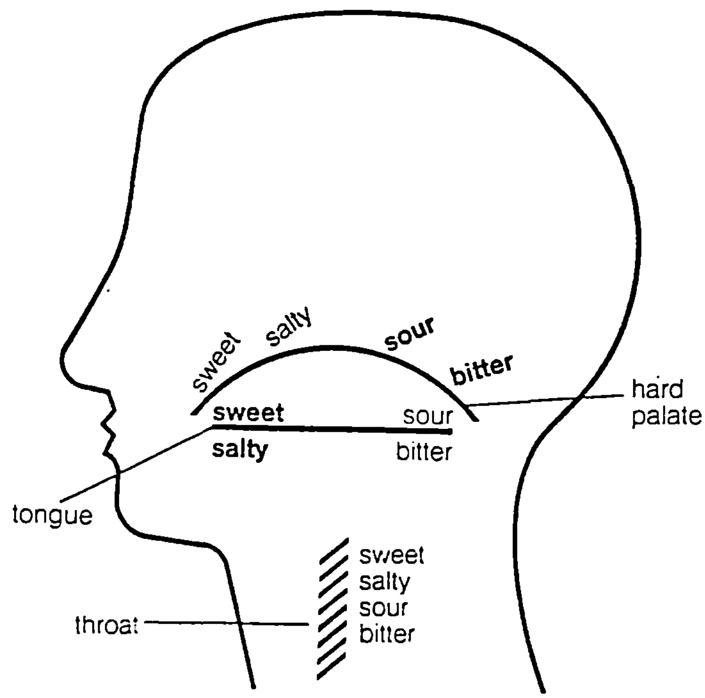


SCHEMATIC OF THE TONGUE SURFACE SHOWING THE TASTE BUD
Source: Pfaffman, Ann. Rev. Psycol. (1976)

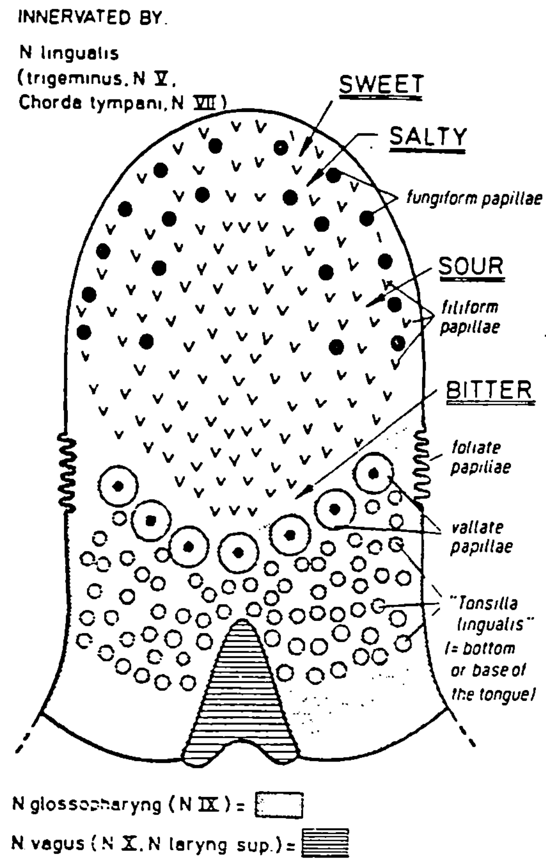
Figure 1. Human Taste Bud

Taste Buds--The Starting Point

Taste receptors or buds are nipple-like projections found throughout the oral cavity, on the hard and soft palate, the pharynx, the larynx, the tongue, the tonsils, the esophagus, and the epiglottis (Bradley, 1979; Parker, 1922). Although they occur most frequently on the papillae of the tongue, the taste buds located on the palate and pharynx do function together with the tongue taste buds to subserve each of the four basic tastes (Henkin and Christiansen, 1966). (Figure 2) Taste buds contain a goblet-shaped array of elongated epithelial cells whose tips protrude through a small pore in the epidermis allowing them to sense the fluid chemistry of the oral cavity (Oakley, 1983). (see figure 3) The tight junctions between the elongated cells on the taste buds prevent taste solutions from directly stimulating the nerve endings (Oakley, 1983). Beidler and Smallman (1965), observed that these cells originate from nearby basal cells whose progeney elongate and differentiate as they move into the bud, where they function as receptor cells for several days before death and replacement. These researchers also showed that the half-life of the taste bud cell was 250 hours +/- 50 hours. This constant renewal of taste receptor cells ensures that viable cells are regenerated in spite of mechanical, thermal, and chemical damage to the tongue. Early research studies linked age-related decreases in taste bud numbers and



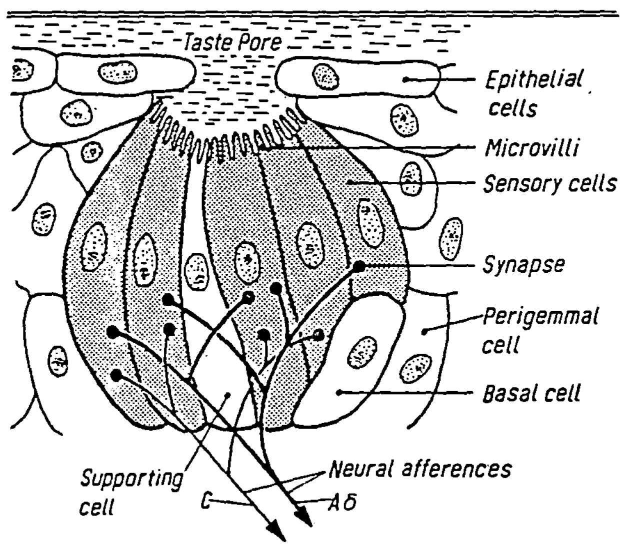
- Areas of different sensitivity for the four basic tastes in healthy men.



Scheme of the tongue surface showing the distribution of the taste papillae, the innervation and the areas of maximal sensitivity for the single taste qualities.

Source: Plattig, Sensory Analysis of Food, (1984)

Figure 2. Location of Taste Sensations



Human taste bud, its structure and innervation. The microvilli of the sensory cells protrude into a fluid-filled space in the taste pore. Only two afferent fibres are drawn, while actually about 50 fibres branch within just one taste bud, which has its cells (about 40–70) assembled like the slices of an orange.

Source: MvBurney, Psychological Bulletin (1979)

Figure 3. Human Taste Pore

atrophy to taste acuity loses (Arey, Tremaine, and Monzingo, 1935; Machizuki, 1937). These studies were conducted on autopised material with no evidence of cause of death, medical history, or without statistical analysis correlating the findings. Machizuki(1939) reported 108 taste buds per papilla in juveniles (birth to 20 years), 136 in mature individuals (21-60 years), and 109 in elderly (61-90 years), then postulated a decrease in taste buds in old age. There was little difference in taste bud number between juvenile and elderly specimens (Mistretta, and Baum, 1984). Arvidson (1979) reported no significant differences in mean numbers of taste buds per papilla as a function of age. Mistretta et al (1984) found no age-related differences in taste bud numbers in fungiform papilla in rats. Bradley, Stedman, and Mistretta (1985), showed no significant differences in numbers of taste buds per fungiform, circumvallate or foliate papilla, or in diameter of taste buds as a function of age in adult Rhesus monkeys. Even though decreases in taste bud numbers have been reported (Arey et al, 1935; Machizucki, 1937; Conger and Wells, 1969) large numbers of buds remain in papillae in old age. Since a major loss of taste buds (up to 85%) from anterior and posterior areas of the rat tongue did not radically alter taste preference behavior (Pfaffmann, 1955), it is unlikely that human taste preference behavior is substantially disturbed due to the reported extent of taste bud loss in old age (Mistretta et al, 1984). The evidence did not support age-related taste losses due to decreases in number of taste buds.

Taste Thresholds & Perception

'Perception' is used to describe the point where a stimulus is first perceived or detected; 'threshold' is used to describe the point at which a flavor is correctly identified. The most used methods for testing stimulus thresholds are the tracking; the staircase method; or lastly, the method of limits or one of its variations, such as the up-and-down method (Engen, 1983). Tests of this type are usually done with pure solutions of the four flavors with the stimuli presented in small steps, starting with extremely dilute levels and progressing to stronger solutions until the subject first perceives or detects a stimulus (perception). Usually the person must continue to stronger solutions before the flavor is correctly identified (taste threshold). Although there are considerable differences in individuals, for most people the difference between the levels of detection and identification decreases with practice.

Unfortunately, researchers frequently interchange the terms perception, detection, and threshold. This leads to a certain amount of confusion. Procedural designs and variations frequently make the direct comparison of results from different studies difficult (Cowart, 1981). In the study of taste sensitivity and perception in humans, detection and recognition (identification) thresholds have been the most commonly used indices. Threshold measuring techniques are time consuming and yield only a single point on the psychophysical function (either the point at which a stimulus can be detected or the point at which some quality of the stimulus can be recognized or identified) (Cowart, 1981). This has led to the suggestion that few conclusions concerning taste development can be drawn from threshold studies as they have little in common with everyday taste experience (Bartoshuk, 1974). However they are valuable in determining effects of age or other conditions on taste perception.

The vast majority of taste investigations have focused on the responses of young (18-25 years) and, to a lessor extent, middle-aged (25-50 years) adults to threshold level stimulus. Thresholds are not absolute values; and the most commonly reported variables that affect taste acuity are age, gender, and smoking habits (Cowart, 1981). There are some indications of gradual but insignificant declines in threshold levels during the middle adult years (Granville et al, 1964; Hinchcliffe, 1958; Murphy, 1979). Males have a higher threshold than females (Cohen and Gitman, 1959; Smith and Davis, 1973; Yasaki, 1976); and smoking raises threshold levels, particulary to bitter (Kaplan, Glanville and Fischer, 1964; Krut, Perrin, and Bronte-Stewart, 1961; Smith and Davies, 1973).

Elderly Taste Perception

For many years it was believed that in the older adult the most substantial changes occured after the ages of 50-60 years. In early testing, older subjects (aged 52-85 years) showed higher detection levels and recognition thresholds of the four basic flavors (Richter and Campbell, 1940; Hinchcliffe, 1958; Bouiliere,Cendron, and Rapaport, 1958; Cooper, Bilash, and Zubek, 1959; Murphy, 1979). However, more recent studies suggest only minimal age-related changes in the sense of taste. (Baum, 1981; Dye and Koziatek, 1981; Grzegorczyk, Jones, and Mistretta, 1979; Moore, Nielson, and Mistretta, 1982; Murphy, 1979; Cowart, 1981; Weiffenback, Baum , and Burghauser, 1982; Mistretta and Baum, 1984). Even among older persons who are medically compromised the frequency of self-perceived taste deficits may in fact be low (Weiffenbach et al, 1982).

The measurement of threshold sensitivity of older persons in a laboratory setting is affected by their decision-making process. Grzegorczyk et al, (1979) have pointed out that older people are often reluctant to confirm the presence of a sensory stimulus in water until that stimulus could clearly by identified. Since different concentrations of a taste solution are perceived as different tastes (Table I), this reluctance is understandable. Age-related declines in olfactory, tactile, or thermal sensitivity might contribute to

TABLE I

TASTE QUALITIES ELICITED IN MAN BY DIFFERENT CONCENTRATIONS OF NACL AND KCL

Concentration (moles/liter)	NaCl	KCL
0.009	No taste	Sweet
0.01	Faintly sweet	Strongly sweet
0.02	Sweet	Sweet,faintly bitter
0.03	Sweet	Bitter
0.04	Salty,faintly sweet	Bitter
0.05	Salty	Bitter,salty
0.1	Salty	Bitter,salty
0.2	Purely salty	Salty,bitter,sour
1.0	Purely salty	salty,bitter,sour

Source: Jellinek, 1985

perceived diminished taste without actually affecting pure gustatory sensitivity in the laboratory (Murphy, 1979). Aqueous solutions of chemical tastants differ in a number of important ways from the foods consumed in real life in that there is no sensations of odor, texture, and temperature. Nevertheless, chemical solutions in studies of age-related taste acuity are not entirely inappropriate. Solutions are easy to control (Cowart, 1981, Grzegorczyk, et al.,1979), and their use provides insight into factors that may play a role in elevating the estimated thresholds of older persons. For instance, Grzegorczyk et al (1979) demonstrated in a two-choice, `up-down' or tracking procedure, six `reversal points'--concentrations at which there was a shift from a correct to an incorrect choice, or vice versa. These were averaged to obtain threshold estimates. When all reversal points were averaged the estimated thresholds of older subjects were higher than the other age groups. However, when only the final reversals were averaged, the threshold values for all groups were lower, with the greatest change in the older subjects. The conclusion drawn was that the elderly require more practice than young adults to perform optimally in a testing situation.

Sensory Evaluation

Jellinek's introduction in her book on Sensory Evaluation of Foods (1985), states:

> We are able to detect and differentiate through our senses the richness of our environment and all its details. Each individual's perception determines his attitudes toward everything that exists on earth. But each individual's world of sensation is very different depending upon its level of development.

Sensation of taste may serve to both direct and motivate individual choices. Other senses--odor, taste, tactile, temperature, and pain also contribute to the perceived pleasantness or unpleasantness of foods. The selection and ingestion of foods, may be influenced by attitudinal, motivational, and cognitive factors (Cowart, 1981). It seems apparent then that specific taste preferences based on environmental development are important in food choices.

The history of sensory analysis dates to the discovery of glucose by Emil Fischer in 1879 and the accidental discovery of saccharin by Remsen and Fahlberg in the same year. These newly synthesized procedures began the golden era of synthetic organic chemistry and the coming of age of food processing (Moskowitz, 1983). Another important development was the observations by Corin (1887) on the taste potency of different acids, one acid tasting more sour than another, which explains the mechanism involved in the taste perception in sourness. This led to producers, 50 years later, enhancing the sourness of pickles with added acid. The sweetness of sugar and sugar substitutes followed the same pathway as acids, with sweetened beverages and other product development techniques. Cohn in 1914, showing the many advances made in sensory chemistry by that time, published an extensive summary on the taste properties of many thousands of organic compounds.

The developing science of sensory analysis borrowed test methods from psychology and trade practitioners. Psychologists in various universities reported studies on improving the measurement of perception by scaling (Moskowitz, 1983). In Beebe-Center's (1932) critical review of the history of the measurement of hedonics or pleasure, it is interesting to see the similiarity between tne measurements of sensory and hedonic reactions to modal stimuli and the measurement of sensory and hedonic reactions to actual food. Thurstone (1927) founded a psychometric laboratory where he developed comparative judgement techniques. Thurstone is recognized as the first scientist to join psychological measurement principles to real world situations (Moskowitz, 1983). Thurstone's "Law of Comparative Judgement"(1927) hypothesized that when people evaluate the acceptability of stimuli, whether foods, fragrances, or model systems, they do so based upon an underlying or internal psychological preference scale.

The next 30 years saw many advances in sensory analysis techniques. The Arthur D. Little Company (1958) developed the Flavor Profile Method which described the actual characteristics or qualities of a food. The Flavor Profile remains a standard procedure for quantifying the quality of flavor. After World War II, the U.S. Army

Quartermaster Corp measured like/dislike of foods on a nine-point hedonic scale (Peryam, Pilfrim, and Peterson, 1954). The late 1950's and early 1960's saw hundreds of scientific papers on the relation between stimulus intensity and sensory magnitude. This started new approaches to sensory evaluation by introducing magnitude estimation to the food industry (Moskowitz and Stone, 1971, Moskowitz, 1983). In 1978, Stone and Sidel introduced an off-shoot of the Flavor Profile Method, which they titled the Quantitative Descriptive Analysis Method, or QDA. The QDA, a linear scale, uses a six inch line, rather than numbers. Panelist profile their perceptions of a series of product characteristics by marking the line at the appropriate point to represent perceptual magnitude or intensity (Stone et al, 1978). QDA is a successful method easily used by novice researchers and semi-trained panelists which gives solid sensory analysis in general and profile analysis in particular. In recent years innumerable advances in sensory evaluation have been used to revolutionize product development, reformulation, and cost reduction. The new psychophysical techniques and philosophy of sensory analysis are currently being used in consumer marketing research (Moskowitz, 1983).

Sensory Evaluation Methods

Sensory evaluation has become a tool available to the food industry for the purpose of product development, improvement, matching and grading; as well as process improvment, cost reduction, supply source maintenance, quality assurance, and storage stability assessment (Sneed, 1977 and IFT, 1981).

The goal of sensory evaluation is to accurately predict consumer preferences. It does this by:

1. Distinguishing between two or more samples in a defined way.
2. Establishing and characterizing, both qualitatively and quantitatively, any existing differences.
3. As certaining changes occurring after processing or during storage.
4. Establishing an acceptance standard.
5. Establishing quality assurance standards.
6. Ascertaining if the relative quality of a sample can be expressed as a numerical value.
7. Grading samples into prespecified classification systems.
8. Establishing relationships among instrumental and sensory data.
9. Establishing degrees of acceptability among samples (Heath, 1978).

Sensory analysis can be carried out scientifically through sensoric testing or non-scientifically through organoleptic testing. Jellinek (1985) defines 'organoleptic testers' as persons with no training in sensory analysis, and a `sensoric testers' or` sensory analyst' as one who works like an instrument, has participated in training courses, and has been selected for his sensory qualifications. Jellinek (1964) describes two classifications of sensory evaluation testing--analytical (objective) tests and affective (subjective) tests. (Table II) Either are highly successful, but each serves different purposes. Analytical (objective) tests involve discrimination and descriptive evaluations. The purpose is to evaluate products `in terms of differences or similarities and identification or quantification of sensory characteristics' (IFT, 1981). These tests are effective when used with scientifically trained panels.

Examples of analytical tests used to either discriminate or describe differences in samples include difference tests (triangle test, paried comparison, duo-trio test, ranking, scoring, and rating/scalar difference test) or sensitivity tests (threshold, dilution). `Analytical tests' are often used to develop new products, improve or match old ones, change production processes, assess quality control and shelf-life, and select and train panelists (IFT, 1981). Analytical descriptive tests provide a detailed, quantifiable analysis of a product characteristic or the product as a whole. Descriptive tests are divided into two categories. They are descriptive analysis (flavor profile, texture profile, and quantitative descriptive analysis) and attribute rating

TABLE II

OUTLINE OF SENSORY EVALUATION METHODS

Classification	Type	Classification	Type
Analytical		Affective	
Discriminative			
Difference	Triangle		Preference
	Paired Comparisons		Ranking
	Sheffe' Test		Rating
	Duo-trio		Hedonic Scales
	Ranking		Food Action Scales
	Scoring		
	Rating/Scalar Difference		
Sensitivity	Threshold		
	Dilution		
Descriptive			
Descriptive Analysis	Flavor Profile		
	Texture Profile		
	Quantitative Descriptive Analysis		
Attribute Rating	Category Scaling		
	Ratio Scaling		

Source: IFT Sensory Evaluation Division, 1981, pg. 53

(category scaling and ratio scaling)(IFT, 1981). Affective test are subjective and are used to evaluate consumer preference or acceptance of a test product (Campbell, Penfield, and Griswold, 1979). Panel members serving on affective taste panels are untrained and serve as representatives of the population. Affective evaluations include paired-comparison, ranking, scaling, and rating tests.

The American Society for Testing and Materials Committee (ASTM,1981) describe attitude scaling (scaling, rating, scoring and grading) as `a means of deciding indications of attitudes or opinions held, usually on a measuring system using marks or value designations'. Standard definitions in which the relationship between the different levels of sensory measurement are classified are listed in increasing order of power---grading, ranking, rating, or scoring (Land and Sheppard, 1984). They are:

> Grading is classification of samples of a product (for quality) by selected assessors on the basis of one or more attributes.

It may use a nominal scale (non-quantitative differences such as brown eggs, elderly panelists', or senior girls).

> Ranking is defined as a method in which a series of three or more samples are presented at the same time and arranged in order of intensity or degree of some designated attribute.

Ranking is an ordinal process and gives no information on the size of differences, quality or preference.

> Rating is a method of classification into catergories on an ordered scale.

This can be illustrated by the AA, A, and B grading of eggs whether they are small, medium, or large.

> Scoring is a form of rating using a numerical scale where the numbers form an interval or ratio scale.

Scoring is illustrated by numbered scales from one to ten with the best receiving a score of ten.

> A scale, as used in rating and scoring, is a continuum divided into spaced successive values, which may be graphic, descriptive or numerical, used in reporting assessments.

Scales may be unipolar (zero at one end) or bipolar (opposite attributes at each end) such as the hedonic like/dislike.

> Scales have different levels (or `strengths' of power) of measurement which may be classified into four divisions (nominal, ordinal, interval, and ratio).

Land and Sheppard (1984) describe individual scaling methods, how they are used in sensory analysis, and the best use of statistical methods. A nominal scale specifies only class affiliation (such as small, medium, or large) or identification with no quantitative relationships. It is frequently used as a preparation for sensory analysis, rarely used quantitatively except by frequency of occurance. Statistically the mode is the basis of comparison and contingency correlation may be used.

Ordinal scales specifies an attribute or class without defined quantitative implication as to size of differences, as in placing samples in order of sweetness. (Table III) It is used to specify amounts where there is no `a priori'information on the intervals between each category, or take the form of a line where only the ends

TABLE III

SAMPLES OF ORDINAL SCALES

Numbered scales:

```
------------------------------------------------------
1     2   3     4     5     6     7     8     9    10
```

Descriptive scales:

```
----------------------------------------------------------------
extremely        very      moderately        slightly      no
sour             sour      sour              sour          sour
```

Unipolar scales:

```
-------------------------------------------------------------
 0    1     2     3     4     5     6     7     8     9    10
```

Descriptive anchor scale:

```
--------------------------------------------------------------too
sweet              enough sweet              not sweet

--------------------------------------------------------------poor
texture                                  good texture

--------------------------------------------------------------like
neither                     dislike
```

Source: Piggott, 1984

(such as `not sweet-too sweet') have verbal anchors. The appropriate measures for comparison are median and percentiles, i.e. non-parametric statistics. An interval scale specifies that successive categories or unit intervals on the scale are equal and the orgin is arbitrary, i.e. not a real zero. (A zero indicates an absence of a perceived attribute). Many sensory scales are assumed to have interval properties, but rarely are these properties demonstrated. The appropriate statistical measures are the arthmetic mean and standard deviation, analysis of variance, t-test, and other parametric techniques.

A ratio scale specifies equal ratios between successive unit intervals and has a true zero. The appropriate measure of comparison is the geometric mean. Parametric statistical techniques may be used to analyze the data (Land and Sheppard, 1984). Another rating test is the Food Action Rating Scale which does not measure specific perceptions of a test sample, but examines the attitude toward it (IFT, 1981).

Statistical Methods

Determining the correct statistical method depends on the specific test objective (Sidel and Stone, 1976). After testing, statistical analysis of data collected aids in drawing conclusions. Prell (1976) summarized statistical methods used in analysing different sensory techniques. (Table IV).

Panel Selection

> The use of panelists as measuring devices is analogous to the use of any scientific instrument to elicit measurements of specific parameters of products under study. The instrument is selected for its capability of providing the desired measurements as accurately and consistently as possible. Instruments must be calibrated to give standardized measurements that can be universally reproduced and interpreted (ASTM, 1981).

General guidelines that apply when selecting sensory evaluation panelists include:

1. interest in participation;
2. availability (the best times for sensory testing being between 10:00-11:00 a.m. and 3:00-4:00 p.m.);
3. normal olfactory and gustatory sensitivity determined by pre-testing) which can be improved by training, oversensitivity may be a disadvantage;
4. ability to produce reliable and consistent results (communication skills, memory, and experience would contribute to reliability);
5. intelligence and ability to follow directions;
6. good attitudes toward the test product;
7. liking for the type of food being tested;
8. general good health (Larmond, 1977; ASTM, 1981; Jellinek, 1985).

Panelists may be recruited from within or outside of an organization from advertisements, personal contacts, or referrals from friends. Researchers have shown men and

TABLE IV

A SUMMARY OF STATISTICAL METHODS USED FOR SENSORY EVALUATION

Method	No. of samples per test	Analysis of data
Single sample (monadic)	1	Analysis of variance
Paired comparison	2	Binomial distribution
Duo-trio	3 (2 identical, 1 different)	Binomial distribution
Triangle	3 (2 identical, 1 different)	Binomial distribution
Rank order	2-7	Rank analysis Analysis of variance
Rating-difference (scalar difference from control)	1-18 (the larger number only if mild-flavored or rated for texture only)	Analysis of variance Rank analysis
Quality rating (scalar scoring)	1-18 (the larger number only if mild-flavored or rated for texture only)	Analysis of variance Rank analysis
Hedonic (verbal or facial)	1-18 (the larger number only if mild-flavored or rated for texture only)	Analysis of variance Rank analysis
Flavor profile	1-5	Graphic presentation
Texture profile	1-5	Graphic presentation
Threshold	5-15	Sequential analysis
Dilution	5-15	Sequential analysis
Food action scale	1-18 (the larger number only if mild-flavored or rated for texture only)	Analysis of variance Rank analysis
Magnitude estimation	1-48	Analysis of variance Economic analysis Factor analysis Graphic presentation Regression analysis
Quantitative descriptive analysis	1-5	Analysis of variance Factor analysis Regression analysis

Adapted from: Prell, *Food Technology*, 1976, pp. 43

women are equally qualified for sensory evaluation, and age is not a determining factor as younger persons have more taste buds, whereas, older persons have better concentrating powers thereby balancing the results. Other factors that may influence test results are smoking habits, eating and drinking foods with lingering after tastes, and using of strong smelling cosmetics.

Intense concentation is required by panel members during sensory analysis procedures, so they should be protected from disturbances from noise, distraction from other panelists, off-odors, and uncomfortable environmental temperatures (ASTM, 1968b). Precautions must be taken to minimize distractions in order to increase evaluation validity. Prospective panelist should be screened to meet minimal qualifications necessary for the testing method and the product being tested. Minimal qualifications include:

1. normal sensory acuity;
2. interest in sensory evaluation;
3. ability to discriminate and reproduce results;
4. ability of sensory sensitivity to be improved through training.

The following are screening guidelines used for panel selection according to ASTM (1981):

1. screen two to three times more panelist then required;
2. use a product similiar to the one to be tested;
3. use similiar test methods during testing and

training to develop panelists familiarity with procedures;

4. progressively vary the difficulty of the screening tests;

5. thoroughly explain test methods and scoring sheets;

6. establish reproducibility by repeating tests.

Panel candidates are first made familiar with their senses by conducting simple exercises such as: recognition test for the four basic tastes (sweet, sour, salty, bitter); odor recognition tests; physiology of aroma perception; aroma recognition tests; and exercises with other senses (tactile and pressure, kinesthetics, temperatures, pain, auditory, color)(Jellinak, 1985).

<u>Panel Training</u>

Guidelines for training panels, both affective and analytical, include orientation, practice, and training steps (ASTM, 1981). The main sensory methods used in training are:

1. Difference tests (to determin whether a difference exist and intensity or type of difference);

2. Ranking tests (samples presented in random order have to be placed in order of increasing intensity of the specified attribute);

3. Descriptive tests (advanced techniques requiring

flavor profile and dilution flavor profile methods).

Amerine, Pangborn and Roessen (1965) discuss the need for standardizing pretesting instructions and the depth of information required by panelists. These instructions include methods to follow prior to and during test procedures. Pretesting instructions must be religiously adherred to for reliable and reproducible results. Basic pretesting instructions for panelists include:

1. food should not be eaten one hour prior to testing;
2. panelists should not smoke, chew gum, or drink anything except water within 30 minutes of testing;
3. panelists refrain from using strong smelling cosmetics or strong flavored oral hygiene materials on day of testing;
4. panelists with colds or sinus conditions should excuse themselves from testing.

As a general rule panelist will need to rinse their mouths prior to testing and frequently during the tests as instructed (Jellinek, 1984; Moskowitz, 1983; Amerine, et al, 1965).

CHAPTER III

TASTE PERCEPTION IN THE ELDERLY

Introduction

More than 11 percent of all Americans are over 65 years of age, and their numbers and spending power are ever increasing. Recognition of the role that taste preferences play in dietary choices has promoted competition in the food industry for a larger share of elderly consumer spending. Sensory evaluation methods play a vital role in this competition in the development of new products for increased profits. More effort and resources are being focused on product development and improvement today than ever before (Stone, 1971:50; Brandt and Arnold, 1971:56). However, when a new product is considered for the elderly, seldom are members of the targeted population actively involved in the development phase.

Although previous research has widely reported the elderly have age-diminished taste acuity, current research tends to refute these claims (Mistretta and Baum, 1984:330; Dye and Koziatek, 1982:313). Researchers commonly use tests which measure detection and identification threshold levels as a means of determining taste acuity. (Table V). Seldom are these procedures developed with the elderly limitations in mind. In a study by Grzegorczyk, Jones and Mistretta (1979:839) the elderly were reluctant to confirm the presence of a chemical in water until that chemical could clearly be indentified. Age-related declines in olfactory, tactile, or thermal sensitivity might contribute to perceived diminished taste without actually affecting pure gustatory sensitivity (Murphy, 1985:50). Studies by both food scientists and psychologists have shown that elderly responses may be affected by test type, response criteria, forced choices, length and quantity of questions, pre-adaptation of taste buds, and even the size of the print on the evaluation forms. A new testing procedure that considers these affectors but still determines basic tastes was designed and used in this study. The objective of the study was to determine the taste acuity of non-institutionalized, active elderly (60+), as determined by flavor detection and identification thresholds, and compare these levels to the thresholds of two other age groups; 20-39 and 40-59 years. These data were then compared to published non-age specific threshold data.

Methods and Materials

Sensory testing was conducted in a controlled

TABLE V

TASTE THRESHOLDS[1] OF A VARIETY OF CHEMICALS

Sweeteners		Acids		Salt		Bitters	
Sucrose[2]	0.01	Hydrochloric	.0009M	Lithium Chloride	.025	Quinine Sulfate	0.000008
Sucrose[2]	0.017	Nitric	.0011	Ammonium Chloride	.004	Quinine Hydrochloride	0.00003
Glucose	0.08	Sulfuric	.001	Sodium Chloride	.01	Strychnine Monohydrochloride	0.0000016
Sodium Saccharin	0.000.23	Formic	.0018	Sodium Chloride	.03	Nicotine	.000019
		Butyric	.0020	Potassium Chloride	.015	Caffeine	0.0007
		Oxalic	.0032	Magnesium Chloride	.015	Urea	0.12
		Lactic	.0016	Calcium Chloride	.01	Magnesium Sulfate	0.0046
		Malic	.0016				
		Tartaric	.0012				
		Citric	.0023				

[1]Concentration expressed in molar weight (molarity – gram molecular weight/liter).
[2]Detection threshold.

Source: Jellinek, Sensory Evaluation of Food, (1985) environment at two locations--the senior citizens center and a sensory evaluation facility at Oklahoma State University (OSU). Interested older persons from the center as well as students, staff, and faculty from OSU were recruited to participate in the study of taste perception.

A basic taste, 12-step increasing concentration aqueous solution series, was developed. This new testing procedure was designed to reduce age-related test stress syndrome. The study determined if the new testing procedure was as effective in determining detection and identification thresholds listed by American Society for Testing and Materials (ASTM, 1968b;32). The new methods were developed for all ages, but especially the elderly engaging in technical testing procedures. The 12-step Detection/Threshold Test involves the element of test practice, with each basic taste replicated three times. Each 12-cup test required participants to record perceived flavors at each concentration level.

Other steps taken to reduce age-related test stress were: testing in familiar, non-threatening environments, group testing with one-on-one interaction with the researcher, unlimited test time allowing non-rushed judgements, simplified forms in large, easy to read print, and repeated reminders there were no wrong answers.

Chemicals used for the four basic tastes of sweet, sour, salty, and bitter were sucrose, citric acid, sodium chloride, and quinine sulfate. Prior to the start of testing, all participants were familiarized with each flavor in a medium strength so that they would begin the testing from the same reference point.

A standardized amount, (one mole per liter) of each chemical (Merck Index, 8th Ed.), was used to develop stock solutions and diluted with double distilled water until twelve concentrations of increasing strength were developed at levels appropriate for each basic taste. (See Appendix A). Each basic taste series was replicated three times with replication order randomized. Solutions of one substance (sucrose, sodium chloride, citric acid, quinine sulfate) were presented, starting with zero-to-three (randomly determined) distilled water blanks. Participants were required to taste each cup, identify a flavor, and rate the flavor intensity on a zero-three scale. (See Appendix A) Participants were requested to record the flavor and perceived intensity at each concentration level to judge reported taste differences of weak-strong concentrations of the same chemical. Additional instructions required the panelists to refrain from retasting passed solutions and not to change previous decisions as the test progressed and a stronger concentration was correctly identified. Water rinses were used liberally before and between the different cups of the test.

Panelists were evaluated on their detection and identification thresholds. In this study a detection threshold was the concentration level where a chemical substance was first perceived but not identified. The identification threshold was the concentration level a chemical solution was correctly identified forllowed by two correctly identified stronger concentrations.

Research Design

A factorial arrangement of treatments in a split-plot experimental design was used, where treatments were the four flavors and the three age groups. F-tests from an analysis of variance (AOV) were used to test for main effects of age and test, and for their interaction. This was followed by least significant difference (LSD) tests used between age groups to determine differences among the age groups in each test. LSD's were also used to determine effectiveness of test practice for each age group. Significance was set at the 0.05 level.

Results and Conclusions

Comparison of Three Age Groups

There were 15 participants in the elderly (60+) group, one man and 14 women. Eight were in the middle-aged (40+) group, three men and five women; and 10 were in the youngest (20+) group, two men and eight women. Two women from the 40+ group and two women from the 60+ group dropped out of the testing before completion.

The F-tests of the AOV indicate a high probability that the differences among the groups were not due to chance for the following:

bitter detection level (Pr<F 0.001),
bitter identification level (Pr<F 0.001),
salt detection level (Pr>F 0.001),
sweet identification level (Pr>F 0.035).

There were no significant differences (Pr> 0.05) among age groups for the detection levels of salt, sweet and sour and the identificantion levels of sour.

The LSD test established the differences between the detection and identification levels of the four flavors for each age group.

1. There were no significant differences between the 20+ and the 40+ age groups' detection and identification levels for all flavors.

2. There were no significant differences between the 20+ and the 60+ age groups' detection or identification levels for sweet, salty, and sour; but there was a significant difference in the detection and identification levels for bitter. The 60+ group was significantly less sensitive to bitter at both the detection and identification levels in the first and second replications. However, the age differences were overcome by the third replication.

3. There were no significant differences between the 40+ and 60+ age groups' detection levels for sweet, salty, or sour, or the identificantion levels for sweet; however, there was a significant difference in the detection levels for bitter and the identification levels for salty, sour, and bitter. The 60+ group showed a significant difference

in the detection levels for bitter in the first and second replication, but no significance was demonstrated in the third replication. This is also the pattern demonstrated in the identification levels for sour, but a signifcant difference is demonstrated in the identification levels for all three replications of the salty flavor.

Comparison with Published Thresholds

A 95% confidence interval was established for comparison of collected data with published threshold levels for each basic flavor. In order to make these comparisons, all data were expressed as the natural log of the concentration levels. (Table VI) The confidence interval was established by taking +/- two times the standard error of the mean of each flavor and each age group's average identification score for each flavor. When the published threshold level fell within the 95% confidence interval, the age group`s identification score was not statistically significant.

The 20+ and 40+ groups' average identification scores did show a statisitcal significance for salty and sweet flavors. They could detect salty and sweet at significantly lower detection levels than the published threshold levels. The 60+ group's average identification scores showed a statistical significance for bitter and sweet. This difference was significantly above the

TABLE VI

COMPARISON OF PANELISTS' MEAN THRESHOLD WITH PUBLISHED THRESHOLDS EXPRESSED AS NATURAL LOGS

PUBLISHED THRESHOLDS	NATURAL LOGS OF PUBLISHED THRESHOLDS	AGE GROUPS 20+	40+	60+
		(95% CONFIDENCE INTERVALS)		
BITTER 0.000008 m/1	-2.53	-2.07 (-2.86 -1.26)	-2.15 (-2.95 -1.35)	-0.69 (-1.49 0.139)
SALT 0.03 m/1	5.7	4.71* (4.08 5.34)	5.03* (4.40 5.16)	5.86 (5.07 6.49)
SOUR 0.0023 m/1	3.14	1.92 (-0.17 3.65)	1.99 (0.26 3.72)	2.64 (0.91 4.37)
SWEET 0.08 m/1	6.68	5.31* (4.94 5.68)	5.69* (5.32 6.06)	5.92* (5.55 6.24)

*Significantly different from published thresholds.

published bitter threshold and below the sweet threshold. (Appendix B)

Effects of Practice

As can be seen in (Appendix B) each age group improved in their ability to identify flavors with repetition, and this improvement was most dramatic in the 60+ group. This signifies that `acuity' is effected by practice and the practice experience is most important in the elderly group. These results are in agreement with data reported by Mistretta and Baum (1984;330), Dye and Koziatek (1982;313), Grzegorczyk, Jones, and Mistretta (1979:835).

Conclusions

Analysis of the data showed that the detection and identification levels for the 60+ group for bitter was significantly higher than the other two age groups. This indicates that the elderly are less sensitive to bitter and supports recent studies (Baum, 1981:106; Dye and Koziatek, 1981:314; Grzegorczyk et al, 1979:836) that indicate that elderly people have a higher threshold for bitter flavor. Further, their mean identification level for salt was higher than the 20+ group, and both salty and sour identifications were higher than the 40+ group. For sweet flavor there were no significant difference in either detection or identification levels of the three age groups.

When compared to the published threshold levels for the four flavors the taste acuity levels established for the 60+ group showed no significant difference for salty, or sour, but showed a significant difference for bitter. This indicates that although our elderly group did not identify salt, sour, or bitter as quickly as the younger groups, only for bitter did they score differently from national averages.

The effects of test practice were established when each adult group was able to improve ability to identify flavors at weaker concentrations with repetition. This improvement was most dramatic in the 60+ group. The element of test practice, a valuable tool in sensory evaluation, benefits all ages but especially points to the effective contribution the elderly can make as sensory evaluation panelists.

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CHAPTER IV

THE ELDERLY AS SENSORY EVALUATIONS PANELISTS IN THE DEVELOPMENT OF A LOW-FAT TURKEY SAUSAGE

INTRODUCTION

Ground turkey meat, particularily dark meat, has been postulated as an economical beef substitute in recipes by turkey producers (Turkey World, 1972; Hamm et al, 1983).

Mechanically deboned turkey meat (MDTM), has been available and used in processed meat products for over a decade. Characterized by its pasty consistency, MDTM has been successfully added (>15%) to the formulations of processed meat products as a meat binder. Numerious studies have looked at the compositional and functional properties of MDTM. Froning, et. al., (1968) looked at the variability in proximate composition; cutting and trimming methods were reported by Goodwin, et. al., (1968) and Saterlee, et. al., (1971). Grunden, et. al.,(1972) reported that the composition of deboned turkey meat ranged as follows: moisture, 63.4% to 73.7%; fat, 12.7% to 22.5%; protein, 11.7% to 12.8%. The composition of MDTM depends on how and where it is processed. Cooked yields and juiciness were investigated by Hooper, et. al.(1965).

Dried yeast protein (DYP) has been added meat for its functional properties such as tenderizing, flavor enhancing and binding characteristics as well as a nutrient supplement (Rha, 1975; Batt and Sinsky, 1984; Kamel, 1981).

It is generally assumed ground meat products are more acceptable with a high fat content. Several studies rated sensory qualities of low-fat (<15%) ground meat products as less acceptable (Kotula, et. al., 1976; Cole et. al., 1960; Kamel, 1978). However, a low-fat (<10%) meat product reported by Foegeding and Ramsey (1968) was rated as acceptable as a higher fat (25.5%) meat product.

Dietary considerations of the ever increasing elderly population are successfully met by low-fat meat products formulated from turkey. Further, the National Health and Nutrition Advisory Board has recommended that all ages lower fat intake to 30% of total calories. Therefore, low-fat meat products can benefit a variety of ages. Further, moderately priced turkey provides high quality protein for those on limited incomes.

Taste sensations serve to direct and motivate eating behavior, and these sensations influence product selection and purchase; therefore, a new food must meet consumer taste preferences. Marketing research indicates 50% of all new foods introduced in the marketplace fail (Crawford, 1977). Reliable sensory evaluations could play a vital role in predicting new product success. Often a new food product is developed for a specific group such as a food specially designed for the elderly population. However, the food industry has seldom used members of the elderly population as sensory panelists.

This study looks at the effective use of elderly persons as trained sensory panelists in the reasearch and development of a low-fat turkey sausage. The effectiveness of the elderly (60+) panel members was compared with a control panel of mixed ages.

Materials and Methods

Panel Selection

The two panels were selected from the Stillwater senior citizens' center and students, staff, and faculty from Oklahoma State University (OSU). The prospective panelists were screened for sensory acuity using the Basic Four Taste Identification Test, Basic Ranking Test, and Odor Identification and Matching Test following the American Society for Testing and Materials (ASTM) procedures (ASTM, 1968b, and ASTM, 1981). The odor test, in addition to more standard odors, included spices common to sausage. Final testing was completed with two panels: eleven elderly (60+) and eight mixed-aged panelists.

Panel Development-Identification/Preference Teat

An Identification/Preference Test was developed for panel development. Panelists were familiarized with the four turkey sausage formulas, unseasoned and seasoned with individual seasonings. Flavor, tenderness, and juiciness were identified as critical characteristics in a sausage product. The panelists evaluated the effects of individual seasonings on the texture, tenderness, and juiciness of each turkey sausage formula, using a 5-point Hedonic scale.

Panelists were familiarized with the Quantitative Descriptive Analysis (QDA) evaluation method (Stone et. al., 1980). The QDA, a linear scale, includes extremes as descriptive anchors, i.e., no salt-too much salt or too bland-too strong. (Appendix C) The QDA was used to measure the perceived intensities of the seasonings in the turkey sausage formulae.

Tenderness, juiciness, and over-all acceptability were rated against a quality reference pork sausage on a 5-point hedonic scale; with 5=very much better and 1=very much poorer than the reference pork sample. (Appendix C)

Preparation of Sausage

A low-fat turkey sausage was developed using 60% flaked thigh meat and 40% whole ground turkey (60/40). A quantity of the 60/40 sausage combination sufficient for the entire development and testing process was ground on a Biro meat grinder using a 1/8 inch sausage plate. MDTM was substituted wt/wt at the 10% level based on sensory data collected by Lyon, et al. (1977); and Uebersax, et al. (1977). DYP was substituted at the 15% level of the dry matter in the 60/40 combination. This 15% level was based on studies using DYP as a tenderizer in meat patties (Kamel, 1981). This produced 4 combinations to be tested; all turkey (60/40), turkey plus MDTM, turkey plus DYP, and turkey plus MDTM and DYP. (Table VII)

Both panels evaluated seasonings normally used in bulk pork sausage and 4 were chosen: salt, black pepper, sage, and chili pepper. The panels tested 3 levels of each seasoning in each meat formula. Each panel's preferred seasoning levels were then combined into 4 final sausage formulae for sensory evaluation and statistical analysis.

Cooking and Sensory Quality

Four-ounce patties were grilled 6 minutes on each side in a teflon frying pan lightly sprayed with a Vegelene spray. The patties were wrapped in foil and kept warm (135° F) in a portable steam tray for 1 hour until served or transported to the testing site. Total cooking loss was determined by difference of weight from the raw to the cooked state.

Testing was conducted in a controlled sensory environment at 2 locations. Portable testing booths were set up at the senior citizen center, in a room

TABLE VII

TURKEY MEAT FORMULAE

FORMULA 1	FORMULA 2	FORMULA 3	FORMULA 4
100% TURKEY	85% TURKEY	90% TURKEY	75% TURKEY
	15% MDTM	10% DYP	15% MDTM
			10% DYP

separate from other activities, adjacent to the sample preparation room. All sensory evaluations by the control panel (mixed-ages), were conducted in 1 of the sensory evaluations laboratories at OSU.

The patties were divided into fourths immediately prior to panel evaluation. An unseasoned control pattie was presented with patties containing 3 levels of individual seasonings. The panelists were instructed to compare the seasoned patties to the control, indicate their preferred seasoniong level, and identify the seasoning. To determine the effect of the individual seasonings on the texture of the cooked meat, the tenderness and juiciness of the patties were judged on a 5-point hedonic scale ranging from extremely tender or juicy to extremely tough or dry. Samples were presented in a random order. Water and unsalted crackers were used between samples to reduce flavor carry-over.

Each panel's preferred seasoning levels were combined for final evaluations of the 4 meat formulae. Although each panel's preferred seasoning levels were different, their final evaluations of combined seasonings used a QDA intensity rating scale and a paired Reference-Preference test. The paired Reference-Preference test rated each turkey sausage formula against a pork sausage as the standard product. An analysis variance for all variables was conducted. Significance was set at the 0.05 level. The Least Significant Difference test (LSD) indicated significance among means.

Results and Discussion

Seasoning Evaluations

The meat formulations are shown in Table VII. Each panel's preferred seasoning levels are shown in Table VIII Their perceived intensity ratings are shown in Table IX. The ratings for the final sausage formulas with combined seasonings are shown in Table X. Formula 4 with turkey, 10% MDTM, and 15% DYP was rated as most tender and most acceptable. This meat formula was prepared with each panel's seasoning blend and substituted in 5 meat recipes for testing, as a breakfast sausage and as a meat substitue.

As a final step in the study, thirty-eight untrained consumers used a like/dislike hedonic scale to rate the product of each panel. The sausage and seasonings developed by the 60+ panel were rated higher (more acceptable) than the mixed-age panel. These rating are listed in Table XI.

Objective Evaluations

Fat content (percent fat) of the 4 formulae, as well as percent fat in a popular pork sausage and a commerical turkey sausage were determined by the Soxhlet ether extraction. Fat percentages are listed in Table XII.

TABLE VIII

RESULTS OF IDENTIFICATION/PREFERENCE TEST
ELDERLY (E) AND MIXED-AGE (MA) PANELS
PERFERRED SEASONING LEVELS

Seasoning	Level	All Turkey	Turkey 15% MDTM	Turkey 10% DYP	Turkey 15% MDTM 10% DYP
SALT	5.0 g	E&MA	MA	MA	MA
	7.5 g			E	
	10.0 g		E		E
BLACK PEPPER	1.0 g	MA	E&MA	E&MA	
	1.5 g	E			E&MA
	2.0 g				
SAGE	1.5 g	MA		MA	MA
	2.0 g	E	MA		E
	2.5 g		E	E	
CHILI PEPPER	1.0 g	E&MA	E	E	MA
	1.5 g		MA	MA	
	1.75 g				E

TABLE IX

COMPARISON OF PREFERRED SEASONING LEVELS WHEN COMBINED IN SAUSAGES MADE WITH THOSE LEVELS FOR BOTH ELDERLY (E) AND MIXED-AGE (MA) PANELS

Seasoning	Formula 1 All Turkey	Formula 2 10% MDTM	Formula 3 15% DYP	Formula 4 MDTM/DYP
SALT	5.0 g(1) (E&MA) enough(2)	5.0 g(1) (MA) enough(2)	5.0 g(1) (MA) enough(2)	5.0 g(1) (MA) enough(2)
		10.0 g (E) too much	7.5 g (E) slightly too much	10.0 g (E) too much
BLACK PEPPER	1.0 g (MA) not enough	1.0 g (E&MA) not enough	1.0 g (E&MA) not enough	1.5 g (E) enough
	1.5 g (E) enough			
SAGE	1.5 g (MA) enough	2.0 g (MA) enough	1.5 g (MA) enough	1.5 g (MA) enough
	2.0 g (E) enough	2.5 g (E) enough	2.5 g (E) enough enough	2.0 g (E)
CHILI PEPPER	1.0 g (E&MA) enough	1.0 g (E) enough	1.0 g (E) enough	1.0 g (MA) enough
		1.5 g (MA) slightly too much	1.5 g (MA) slightly too much	1.75 g (MA) too much

(1) Amount chosen during sausage development phase
(2) Sensory rating of preferred combined seasoning levels

TABLE X

PANEL RESULTS USING REFERENCE/PREFERENCE TEST FOR FINAL SAUSAGE FORMULAE RATED AGAINST A GOOD QUALITY PORK SAUSAGE

	Formula 1 Turkey 10% MDTM		Formula 2 Turkey 15% DYP		Formula 3 Turkey 10% MDTM 15% DYP		Formula 4 Turkey Only	
Catergory	E	MA	E	MA	E	MA	E	MA
Tenderness	3.5	3.3	3.9	3.6	3.9	3.1	4.0	4.0
Juiciness	3.5	2.8	3.4	2.1	3.4	2.4	3.7	3.5
Overall Acceptability	3.5	2.5	3.4	2.3	3.4	2.4	3.6	3.0

Rating scale:
5=very much better than pork sausage
4=slightly better than pork sausage
3=neither better nor poorer pork sausage
2=slightly poorer than pork sausage
1=very much poorer than pork sausage

TABLE XI

PERCENTAGE OF CONSUMERS* PREFERRING EACH
PANELS' SAUSAGE FORMULA

	PANEL	
SAUSAGE FOODS RATED	60+	MIXED AGE
	PER CENT	PER CENT
SAUSAGE PATTIES	57	42
SAUSAGE/RICE SALAD	61	39
SLOPPY TOMS ON BUNS	54	64
SWEDISH TURKEY BALLS ON NOODLES	71	29
SAUSAGE CAKE	46	54

*N=28 CONSUMERS

TABLE XII

COMPARISON OF PERCENT FAT IN TURKEY SAUSAGE FORMULAE AND COMMERICAL TURKEY AND PORK SAUSAGE USING SOXHLET EXTRACTION

	PERCENT FAT	
	TRIAL 1	TRAIL 2
TURKEY THIGH MEAT	5.1	4.9
TURKEY, WHOLE GROUND	12.0	11.9
MDTM	13.0	12.5
FORMULA 1 (60/40 TURKEY)	8.2	8.0
FORMULA 2 (TURKEY+MDTM)	10.1	10.4
FORMULA 3 (TURKEY+DYP)	7.8	7.5
FORMULA 4 (TURKEY+MDTM+DYP)	6.7	6.0
LOUIS RICH TURKEY SAUSAGE	13.1	12.9
JIMMY DEAN PORK SAUSAGE	18.5	18.0

Tenderness based on penetration distance was determined using a penetrometer. Three samples of each formula plus the pork sausage and commercial turkey sausage were tested; all were fresh cooked, held warm one hour, and cooled. This test was repeated two times. Tenderness ratings are in Table XIII.

Statistical Analysis

The F-tests from the analysis of variance of the combined seasoning blends in the 4 sausage formulae showed significant ratings for seasonings in Formulae 1, 3 and 4.

In Formula 1 (all turkey), the 60+ group perceived the salt more intensely than in the other 3 formulae or by the mixed-age group. An LSD with a probability of 0.01 indicates this is due to age and not chance. The 60+ group perceived black pepper significantly higher in formula 1 than in the other three formulae and higher than the mixed-age group. However, in Formula 3 (turkey plus MDTM), the mixed age panel rated the black pepper significantly lower than in the other 3 formulae and lower than the 60+ panel.

In Formula 4 (turkey, MDMT, and DVP) the mixed-age panel rated chili pepper higher than in the other three formulae and higher than the 60+ panel. (Appendix C)

TABLE XIII

RESULTS OF PENETROMETER MEASUREMENTS FOR TENDERNESS UNDER THREE SERVING CONDITIONS

	FRESH COOKED		HELD ONE HOUR		COOLED ONE HOUR	
TRIALS	1	2	1	2	1	2
	NM*		NM		MN	
FORMULA 1	35	37	36	34	33	30
FORMULA 2	62	60	50	53	40	42
FORMULA 3	60	58	51	47	44	39
FORMULA 4	95	98	76	81	53	59
LOUIS RICH	63	62	56	55	45	44
JIMMY DEAN	122	126	55	53	44	46

DISTANCE IN NANOMETERS--1/10 MM MEASURED OVER TIME

Conclusions

The results indicate the elderly make effective sensory panelists. Their ability to accurately predict consumer preferences, in this study, indicates they would make a valauble contribution to the food industry.

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CHAPTER V

HYPOTHESES TESTING AND RECOMMENDATIONS

The purpose of this study was to establish and compare the taste detection and identification levels of three age groups, 20-39, 40-59, and 60+ years with the intent of training the 60+ group as sensory evaluation panelists for product development.

Hypothesis Testing

In order to accomplish the purpose of the study the testing procedures and results had to be as sensitive as and comparable to recognized standard testing procedures. To determine this, these hypothesis were developed and tested.

The first hypothesis (H1) stated that there would be no significant differences in the ability to detect and identify flavors and odors among the three age groups. The results showed no significant differences between the 20+ and 40+ age groups, but there was a significant difference for bitter flavor between the 60+ age group and the other two groups, in that the 60+ group were significantly less sensitive to the bitter flavor. Based on these results the researcher rejected H1.

The second hypotheses (H2) stated that there would be no significant differences in the thresholds levels of the three age group's and published threshold levels. The results showed that threshold levels of the 20+ and 40+ groups were below the published threshold levels for all four flavors. The 60+ groups threshold levels were below the published threshold levels for sweet and sour, was slightly above for salt which was not significant, but was significantly higher for bitter. Based on these results, the researcher rejected H2.

The third hypotheses (H3) stated that there would be no significant difference in the sensory judgements of the individual panelists on repeated evaluations. The results indicate individual panelists were able to rate the sausage characteristics on some replicated samples. However, there were differences close to the significant level, which indicate further testing is needed in this area. Based on these results, the researcher rejects H3.

It was concluded from this study that the 60+ age group did show a significantly higher threshold level for bitter, but with test practice the age-related differences shown between age groups and among replications were reduced to non significance by the third replication. As product development panelists, the 60+ group showed a tendency for a possibile lack of reproducibility on repeated samples. This area needs further investigation.

Recommendations

Further studies using test practice as a training procedure is encouraged.

The large independently living, elderly population can be a valuable asset to the food industry in some forms of sensory evaluations.

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APPENDIX

APPENDIX A

TASTE ACUITY INSTRUMENTATION

CHEMICAL MOLARITIES

BASIC TASTE INTENSITIES

PANELIST CODE NUMBER ________

IN FRONT OF YOU ARE SEVERAL CUPS CONTAINING WEAK WATER SOLUTIONS REPRESENTING ONE OF THE BASIC TASTE SENSATIONS. ONE OR MORE OF THESE MAY BE A BLANK (WATER ONLY). RINSE YOUR MOUTH WITH WATER BEFORE BEGINNING. TASTE EACH CUP OF SOLUTION, ONE CUP AT A TIME, STARTING WITH THE CUP IN THE UPPER LEFT CORNER. RECORD AS NO TASTE OR A FLAVOR OF SWEET, SOUR, SALTY, OR BITTER. REMEMBER SOME FLAVORS TASTE DIFFERENTLY IN WEAK SOLUTIONS. DO NOT CHANGE YOUR ANSWER. THERE ARE NO RIGHT OR WRONG ANSWERS. ONCE YOU HAVE TASTED A CUP OF SOLUTION RETASTING IS NOT ALLOWED. RINSE YOUR MOUTH BETWEEN EACH CUP OF SOLUTION. PLEASE INDICATE AN INTENSITY RATING FOR EACH SOLUTION USING THE INTENSITY SCALE AT THE BOTTOM. CIRCLE THE CORRECT CHOICE OF FLAVOR AT THE END OF THE TEST.

FLAVOR	INTENSITY
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	

INTENSITY SCALE

0 - NO FLAVOR

? - DIFFERENT THAN WATER, BUT CANNOT IDENTIFY

1 - I AM NOT COMPLETELY SURE

2 - I AM PRETTY SURE

3 - I AM DEFINITLY SURE

THE FLAVOR IS SWEET SOUR, SALTY, BITTER. (PLEASE CIRCLE ONE).

Basic Flavor Test

Panelist code number__ ____

Four coded samples are presented. Taste each sample and indicate if it is sweet, salty, sour, or bitter.

Sample code	Flavor
151	________
455	________
385	________
262	________

BASIC TASTE INTENSITIES

Panelist code number 923

In front of you are six cups containing weak water solutions of flavorings representing the basic taste sensations. One or more of these may be a blank (water only). Your task is to place them in order from the weakest to the strongest.

Sample Code

Weakest ________

____

____

____

____

Strongest ________

The flavor is sweet, sour, salty, bitter. (Please circle one).

ODOR IDENTIFICATION

PANELIST CODE NUMBER______________

Six bottles are presented which contain a common household odor. Please sniff each sample. Record the sample number opposite the name of the odor below. If you can not identify the odor, describe a similiar odor. Wait 15 seconds between samples.

SAMPLE CODE	ODOR DESCRIPTION
___________	vanilla
___________	strawberry
___________	cinnamon
___________	garlic
___________	clove
___________	licorice
___________	lemon
___________	peppermint

SWEETNESS RANKING

YOU HAVE BEEN GIVEN THREE SAMPLES OF PEACHES. EACH SAMPLE HAS A DIFFERENT SWEETNESS LEVEL. RANK THE PEACHES FROM THE LEAST SWEET TO THE MOST SWEET. RECORD YOUR ANSWERS BELOW.

LEAST SWEET	MEDIUM SWEET	MOST SWEET

Chemicals and Molarities Used in Tests

Taste: Salty   Threshold 0.03 moles/liter
Material: NaCl-Sodium Chloride
Molecular Weight: 58.45 gm/mole.
Stock Solution-A-46.72 gm/liter=.8 moles/liter

Solution #	Molarity	Sol. A/ ml water
1	.0016	1 ml Sol A / 500 ml Water
2	.0032	2 " " " " " "
3	.0064	4 " " " " " "
4	.0128	8 " " " " " "
5	.0256	16 " " " " " "
6	.032	20 " " " " " "
7	.0512	32 " " " " " "
8	.064	40 " " " " " "
9	.1024	64 " " " " " "
10	.128	80 " " " " " "
11	.2048	128 " " " " " "
12	.256	160 " " " " " "

Taste: Sour   Threshold 0.0023 moles/liter
Material: Citric Acid
Molecular Weight: 210.15 gm/mole
Stock Solution-B-21.015 gm/liter = .1 mole/liter

Solution #	Molarity	Sol. B / ml Water
1	.0001	.5 ml B / 500 ml Water
2	.0002	1 " " " " "
3	.0004	2 " " " " "
4	.0008	4 " " " " "
5	.0016	8 " " " " "
6	.0020	10 " " " " "
7	.0032	16 " " " " "
8	.0064	32 " " " " "
9	.0128	64 " " " " "
10	.0248	124 " " " " "
11	.0496	248 " " " " "
12	.0992	496 " " " " "

Chemicals and Molarities Used in Tests

Taste: Bitter Threshold 0.000008 moles/liter
Material: Quinine Sulfate
Molecular Weight: 324.41 gm/mole.
Stock Solution-C- 2.54 gm/liter = .007 moles/liter

Solution #	Molarity	Sol. C / ml Water
1	.0000035	.5 ml Sol. C/1000ml Water
2	.000007	1 " " " " "
3	.000024	2 " " " " "
4	.000021	3 " " " " "
5	.000042	6 " " " " "
6	.000084	12 " " " " "
7	.000126	18 " " " " "
8	.000168	24 " " " " "
9	.00021	30 " " " " "
10	.00028	40 " " " " "
11	.00035	50 " " " " "
12	.00042	60 " " " " "

Taste:Sweet
Material: Sucrose
Molecular Weight: 342.30 gm / mole
Stock Solution D-102.69 gm / liter=0.3 moles / liter

Solution #	Molarity	Sol. D / ml Water
1	.006	10 ml Sol. D/ 500 ml Water
2	.012	20 " " " " " "
3	.018	30 " " " " " "
4	.024	40 " " " " " "
5	.030	50 " " " " " "
6	.042	70 " " " " " "
7	.084	140 " " " " " "
8	.096	160 " " " " " "
9	.168	280 " " " " " "
10	.204	70.103 gm sucrose/500ml water
11	.409	140.206 " " " " "
12	.819	280.4 " " " " "

APPENDIX B

ANALYSIS OF VARIANCE TABLES

F-TEST

FLAVOR=BITR

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: DETLVL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	44.28589329	1.23016370	4.88	0 0001	0.761417	125.7209
ERROR	55	13.87656362	0.25230116		ROOT MSE		DETLVL MEAN
CORRECTED TOTAL	91	58.16245690			0.50229589		0.39953261

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	11.17289912	22.14	0.0001	2	10.93413353	21.67	0.0001
SUBJECT(AGE)	28	13.94456378	1.97	0.0157	28	13.94623548	1.97	0.0157
PERIOD	2	8.27602280	16.40	0.0001	2	8.27602280	16.40	0.0001
AGE*PERIOD	4	10.89240758	10.79	0.0001	4	10.89240758	10.79	0.0001

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	11.15802355	22.11	0.0001
SUBJECT(AGE)	28	13.94623548	1.97	0.0157
PERIOD	2	4.33042618	8.58	0.0006
AGE*PERIOD	4	10.89240758	10.79	0.0001

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	11.15802355	11.20	0.0003

FLAVOR=BITR

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOGDET

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	101.43446561	2.81762404	6.80	0.0001	0.816442	34.2741
ERROR	55	22.80525578	0.41464101		ROOT MSE		LOGDET MEAN
CORRECTED TOTAL	91	124.23972139			0.64392625		-1.87875484

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	42.53646509	51.29	0.0001	2	41.98189670	50.62	0.0001
SUBJECT(AGE)	28	29.02684696	2.50	0.0018	28	29.07387732	2.50	0.0018
PERIOD	2	13.38604342	16.14	0.0001	2	13.38604342	16.14	0.0001
AGE*PERIOD	4	16.48511014	9.94	0.0001	4	16.48511014	9.94	0.0001

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	42.74598458	51.55	0.0001
SUBJECT(AGE)	28	29.07387732	2.50	0.0018
PERIOD	2	6.70218001	8.08	0.0008
AGE*PERIOD	4	16.48511014	9.94	0.0001

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	42.74598458	20.58	0.0001

FLAVOR=BITR

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RECLVL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	79.11524098	2.19764558	5.40	0.0001	0.788994	116.7702
ERROR	52	21.15832854	0.40689093		ROOT MSE		RECLVL MEAN
CORRECTED TOTAL	88	100.27356953			0.63788003		0.54626966

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	19.30812470	23.73	0.0001	2	20.31990291	24.97	0.0001
SUBJECT(AGE)	28	32.07872816	2.82	0.0006	28	30.95924161	2.72	0.0009
PERIOD	2	10.41512819	12.80	0.0001	2	10.41512819	12.80	0.0001
AGE*PERIOD	4	17.31325993	10.64	0.0001	4	17.31325993	10.64	0.0001

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	21.91373213	26.93	0.0001
SUBJECT(AGE)	28	30.95924161	2.72	0.0009
PERIOD	2	6.31035677	7.75	0.0011
AGE*PERIOD	4	17.31325993	10.64	0.0001

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	21.91373213	9.91	0.0006

FLAVOR=BITR

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOGREC

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	94.91373803	2.63649272	6.54	0.0001	0.819090	41.4462
ERROR	52	20.96335500	0.40314144		ROOT MSE		LOGREC MEAN
CORRECTED TOTAL	88	115.87709303			0.63493420		-1.53194815

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	39.67897252	49.21	0.0001	2	40.73485086	50.52	0.0001
SUBJECT(AGE)	28	36.94365388	3.27	0.0001	28	36.56074360	3.24	0.0001
PERIOD	2	6.40889701	7.95	0.0010	2	6.40889701	7.95	0.0010
AGE*PERIOD	4	11.88221463	7.37	0.0001	4	11.88221463	7.37	0.0001

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	42.31113639	52.48	0.0001
SUBJECT(AGE)	28	36.56074360	3.24	0.0001
PERIOD	2	3.13377940	3.89	0.0267
AGE*PERIOD	4	11.88221463	7.37	0.0001

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	42.31113639	16.20	0.0001

FLAVOR=SALT

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: DETLVL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	35	1605603.74388523	45874.39268244	4.06	0.0001	0.735891	85.3748
ERROR	51	576246.00324121	11298.94124002		ROOT MSE		DETLVL MEAN
CORRECTED TOTAL	86	2181849.74712644			106.29647802		124.50574713

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	282784.55073004	12.51	0.0001	2	282555.73806443	12.50	0.0001
SUBJECT(AGE)	27	1217934.52972973	3.99	0.0001	27	1218111.00401820	3.99	0.0001
PERIOD	2	83006.73580247	3.67	0.0323	2	83006.73580247	3.67	0.0323
AGE*PERIOD	4	21877.92762299	0.48	0.7473	4	21877.92762299	0.48	0.7473

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	240701.47674301	10.65	0.0001
SUBJECT(AGE)	27	1218111.00401820	3.99	0.0001
PERIOD	2	62747.27068273	2.78	0.0717
AGE*PERIOD	4	21877.92762299	0.48	0.7473

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	240701.47674301	2.67	0.0877

FLAVOR=SALT

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOGDET

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	35	43.95441960	1.25584056	2.90	0.0003	0.665699	15.0593
ERROR	51	22.07309804	0.43280584		ROOT MSE		LOGDET MEAN
CORRECTED TOTAL	86	66.02751764			0.65787981		4.36859539

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	7.83464407	9.05	0.0004	2	7.87250200	9.09	0.0004
SUBJECT(AGE)	27	33.89680100	2.90	0.0005	27	33.83382202	2.90	0.0005
PERIOD	2	1.86565659	2.16	0.1263	2	1.86565659	2.16	0.1263
AGE*PERIOD	4	0.35731793	0.21	0.9337	4	0.35731793	0.21	0.9337

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	7.06305924	8.16	0.0008
SUBJECT(AGE)	27	33.83382202	2.90	0.0005
PERIOD	2	1.92223802	2.22	0.1189
AGE*PERIOD	4	0.35731793	0.21	0.9337

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	7.06305924	2.82	0.0773

FLAVOR=SALT

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RECLVL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	34	4476768.30476190	131669.65602241	3.84	0.0001	0.727192	64.4534
ERROR	49	1679470.93333334	34274.91700680		ROOT MSE		RECLVL MEAN
CORRECTED TOTAL	83	6156239.23809524			185.13486167		287.23809524

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	1899884.85378151	27.72	0.0001	2	1904716.77300753	27.79	0.0001
SUBJECT(AGE)	26	2488418.38431372	2.79	0.0010	26	2494189.71428570	2.80	0.0009
PERIOD	2	23675.35985853	0.35	0.7097	2	23675.35985853	0.35	0.7097
AGE*PERIOD	4	64789.70680813	0.47	0.7556	4	64789.70680813	0.47	0.7556

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	1750119.72868091	25.53	0.0001
SUBJECT(AGE)	26	2494189.71428571	2.80	0.0009
PERIOD	2	34316.45175846	0.50	0.6092
AGE*PERIOD	4	64789.70680813	0.47	0.7556

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	1750119.72868091	9.12	0.0010

FLAVOR=SALT

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOGREC

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	34	57.09236618	1.67918724	5.32	0.0001	0.786855	10.6747
ERROR	49	15.46531144	0.31561860		ROOT MSE		LOGREC MEAN
CORRECTED TOTAL	83	72.55767763			0.56179943		5.26292383

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	23.07358574	36.55	0.0001	2	23.31626584	36.94	0.0001
SUBJECT(AGE)	26	30.34349676	3.70	0.0001	26	30.14706525	3.67	0.0001
PERIOD	2	1.64076708	2.60	0.0845	2	1.64076708	2.60	0.0845
AGE*PERIOD	4	2.03451659	1.61	0.1863	4	2.03451659	1.61	0.1863

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	21.32449663	33.78	0.0001
SUBJECT(AGE)	26	30.14706525	3.67	0.0001
PERIOD	2	1.93591385	3.07	0.0556
AGE*PERIOD	4	2.03451659	1.61	0.1863

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	21.32449663	9.20	0.0010

FLAVOR=SOUR

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: DETLVL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	1450.76639303	40.29906647	1.79	0.0250	0.539789	90.8929
ERROR	55	1236.88578089	22.48883238		ROOT MSE		DETLVL MEAN
CORRECTED TOTAL	91	2687.65217391			4.74223917		5.21739130

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	34.07561889	0.76	0.4736	2	33.68620937	0.75	0.4776
SUBJECT(AGE)	28	1246.24322169	1.98	0.0153	28	1253.09848485	1.99	0.0147
PERIOD	2	127.52258065	2.84	0.0673	2	127 52258065	2.84	0.0673
AGE*PERIOD	4	42.92497180	0.48	0.7523	4	42.92497180	0.48	0.7523

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	32.35755190	0.72	0.4916
SUBJECT(AGE)	28	1253.09848485	1.99	0.0147
PERIOD	2	120.53290960	2 68	0.0775
AGE*PERIOD	4	42.92497180	0.48	0.7523

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	32.35755190	0.36	0.6998

FLAVOR=SOUR

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOGDET

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	33.99407010	0.94427972	2.70	0.0004	0.638861	44.4949
ERROR	55	19.21636972	0.34938854		ROOT MSE		LOGDET MEAN
CORRECTED TOTAL	91	53.21043982			0.59109097		1.32844617

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	4.56504312	6.53	0.0028	2	4.56060669	6.53	0.0029
SUBJECT(AGE)	28	26.06490775	2.66	0.0009	28	26.13914779	2.67	0 0009
PERIOD	2	2.51000678	3.59	0.0342	2	2.51000678	3.59	0.0342
AGE*PERIOD	4	0 85411244	0.61	0.6564	4	0.85411244	0.61	0.6564

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	4.52943702	6.48	0.0030
SUBJECT(AGE)	28	26.13914779	2.67	0.0009
PERIOD	2	2.09310609	3.00	0.0582
AGE*PERIOD	4	0.85411244	0.61	0.6564

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	4.52943702	2.43	0.1067

FLAVOR=SOUR

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RECLVL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	454281.00322437	12618.91675623	0.93	0.5789	0.412192	349.5509
ERROR	48	647830.29089328	13496.46439361		ROOT MSE		RECLVL MEAN
CORRECTED TOTAL	84	1102111.29411765			116.17428456		33.23529412

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	50997.70417457	1.89	0.1622	2	51266.85364776	1.90	0.1608
SUBJECT(AGE)	28	345658.25660974	0.91	0.5920	28	335025.01939643	0.89	0.6271
PERIOD	2	35481.41347150	1.31	0.2781	2	35481.41347150	1.31	0.2781
AGE*PERIOD	4	22143.62896855	0.41	0.8004	4	22143.62896855	0.41	0.8004

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	42752.91312596	1.58	0.2157
SUBJECT(AGE)	28	335025.01939643	0.89	0.6271
PERIOD	2	25729.49759638	0.95	0.3927
AGE*PERIOD	4	22143.62896855	0.41	0.8004

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	42752.91312596	1.79	0.1861

FLAVOR=SOUR

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOGREC

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	79.44074151	2.20668726	2.55	0.0013	0.656355	41.7362
ERROR	48	41.59242556	0.86650887		ROOT MSE		LOGREC MEAN
CORRECTED TOTAL	84	121.03316707			0.93086458		2.23035554

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	12.00522395	6.93	0.0023	2	12.40252296	7.16	0.0019
SUBJECT(AGE)	28	54.79227220	2.26	0.0064	28	51.04128295	2.10	0.0115
PERIOD	2	10.67185983	6.16	0.0042	2	10.67185983	6.16	0.0042
AGE*PERIOD	4	1.97138554	0.57	0.6865	4	1.97138554	0.57	0.6865

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	8.72867421	5.04	0.0103
SUBJECT(AGE)	28	51.04128295	2.10	0.0115
PERIOD	2	8.70020614	5.02	0.0105
AGE*PERIOD	4	1.97138554	0.57	0.6865

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	8.72867421	2.39	0.1097

FLAVOR=SWEE

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: DETLVL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	2992063.03696304	83112.86213786	5.52	0.0001	0.786284	56.2314
ERROR	54	813255.64435565	15060.28971029		ROOT MSE		DETLVL MEAN
CORRECTED TOTAL	90	3805318.68131868			122.72037203		218.24175824

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	176258.29854356	5.85	0.0050	2	177005.74772009	5.88	0.0049
SUBJECT(AGE)	28	2712860.38277512	6.43	0.0001	28	2715616.18381618	6.44	0.0001
PERIOD	2	32931.31425396	1.09	0.3424	2	32931.31425396	1.09	0.3424
AGE*PERIOD	4	70013.04139040	1.16	0.3377	4	70013.04139040	1.16	0.3377

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	170782.06952846	5.67	0.0058
SUBJECT(AGE)	28	2715616.18381618	6.44	0.0001
PERIOD	2	36646.94395103	1.22	0.3042
AGE*PERIOD	4	70013.04139040	1.16	0.3377

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	170782.06952846	0.88	0.4258

FLAVOR=SWEE

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOGDET

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	20.14007559	0.55944654	3.87	0.0001	0.720698	7.3199
ERROR	54	7.80514460	0.14453971		ROOT MSE		LOGDET MEAN
CORRECTED TOTAL	90	27.94522019			0.38018379		5.19386298

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	2.45641474	8.50	0.0006	2	2.44789845	8.47	0.0006
SUBJECT(AGE)	28	16.63735952	4.11	0.0001	28	16.66723067	4.12	0.0001
PERIOD	2	0.49590568	1.72	0.1895	2	0.49590568	1.72	0.1895
AGE*PERIOD	4	0.55039566	0.95	0.4414	4	0.55039566	0.95	0.4414

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	2.43310147	8.42	0.0007
SUBJECT(AGE)	28	16.66723067	4.12	0.0001
PERIOD	2	0.49806227	1.72	0.1882
AGE*PERIOD	4	0.55039566	0.95	0.4414

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	2.43310147	2.04	0.1484

FLAVOR=SWEE

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: RECLVL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	9511922.09790210	264220.05827506	4.43	0.0001	0.750710	63.5742
ERROR	53	3158637.90209790	59596.94154902		ROOT MSE		RECLVL MEAN
CORRECTED TOTAL	89	12670560.00000000			244.12484828		384.00000000

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	1362424.73684211	11.43	0.0001	2	1393915.42294708	11.69	0.0001
SUBJECT(AGE)	28	7548535.26315789	4.52	0.0001	28	7455754.46553445	4.47	0.0001
PERIOD	2	183071.18644068	1.54	0.2247	2	183071.18644068	1.54	0.2247
AGE*PERIOD	4	417890.91146142	1.75	0.1522	4	417890.91146142	1.75	0.1522

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	1375498.26773895	11.54	0.0001
SUBJECT(AGE)	28	7455754.46553445	4.47	0.0001
PERIOD	2	108777.79386790	0.91	0.4077
AGE*PERIOD	4	417890.91146142	1.75	0.1522

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	1375498.26773895	2.58	0.0934

FLAVOR=SWEE

GENERAL LINEAR MODELS PROCEDURE

DEPENDENT VARIABLE: LOGREC

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F	R-SQUARE	C.V.
MODEL	36	32.29141202	0.89698367	4.85	0.0001	0.767294	7.5893
ERROR	53	9.79337366	0.18478064		ROOT MSE		LOGREC MEAN
CORRECTED TOTAL	89	42.08478568			0.42986118		5.66401333

SOURCE	DF	TYPE I SS	F VALUE	PR > F	DF	TYPE II SS	F VALUE	PR > F
AGE	2	6.13111447	16.59	0.0001	2	6.28923343	17.02	0.0001
SUBJECT(AGE)	28	23.78880552	4.60	0.0001	28	23.65909700	4.57	0.0001
PERIOD	2	1.09995157	2.98	0.0596	2	1.09995157	2.98	0.0596
AGE*PERIOD	4	1.27154046	1.72	0.1592	4	1.27154046	1.72	0.1592

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	6.37671154	17.25	0.0001
SUBJECT(AGE)	28	23.65909700	4.57	0.0001
PERIOD	2	0.67127739	1.82	0.1726
AGE*PERIOD	4	1.27154046	1.72	0.1592

TESTS OF HYPOTHESES USING THE TYPE III MS FOR SUBJECT(AGE) AS AN ERROR TERM

SOURCE	DF	TYPE III SS	F VALUE	PR > F
AGE	2	6.37671154	3.77	0.0354

	PERIOD 1	PERIOD 2	PERIOD 3	PP AVE
AGE				
20	0.108	0.092	0.092	0.098
40	0.079	0.120	0.107	0.102
60	1.772	0.513	0.132	0.806
AA				
AVE	0.799	0.275	0.112	0.396

Mean of Detection Flavor=Bitter

	PERIOD 1	PERIOD 2	PERIOD 3	PP AVE
AGE				
20	0.146	0.121	0.127	0.131
40	0.082	0.258	0.197	0.179
60	2.457	0.642	0.414	1.171
AA				
AVE	1.101	0.370	0.263	0.578

Mean of Recognition Flavor=Bitter

	PERIOD			PP
	1	2	3	AVE
AGE				
20	-2.344	-2.533	-2.533	-2.470
40	-2.581	-2.457	-2.361	-2.467
60	-0.011	-1.109	-2.139	-1.086
AA				
AVE	-1.419	-1.919	-2.329	-1.889

Mean of Log Detection Flavor=Bitter

	PERIOD			PP
	1	2	3	AVE
AGE				
20	-1.955	-2.181	-2.095	-2 077
40	-2.399	-2.080	-1.961	-2.147
60	0.270	-0.861	-1.463	-0.685
AA				
AVE	-1.122	-1.605	-1.800	-1.509

Mean of Log Recognition Flavor=Bitter

	PERIOD 1	PERIOD 2	PERIOD 3	PP AVE
AGE				
20	73.600	92.800	51.200	72.533
40	81.905	105.143	64.000	83.683
60	175.105	247.385	130.462	184.317
AA				
AVE	119.523	162.667	88.533	123.574

Mean of Detection Flavor=Salt

	PERIOD 1	PERIOD 2	PERIOD 3	PP AVE
AGE				
20	176.000	163.200	86.400	141.867
40	190.857	246.857	150.857	196.190
60	438.400	455.200	479.200	457.600
AA				
AVE	293.173	309.253	271.653	291.360

Mean of Recognition Flavor=Salt

	PERIOD			PP
	1	2	3	AVE
AGE				
20	4.159	4.228	3.743	4.043
40	4.258	4.456	4.060	4.258
60	4.681	4.799	4.585	4.688
AA				
AVE	4.408	4.529	4.182	4.373

Mean of Log Detection Flavor=Salt

	PERIOD			PP
	1	2	3	AVE
AGE				
20	4.921	4.921	4.298	4.713
40	5.056	5.280	4.753	5.030
60	5.904	5.790	5.908	5.867
AA				
AVE	5.378	5.382	5.102	5.287

Mean of Log Recognition Flavor=Salt

	PERIOD			PP
	1	2	3	AVE
AGE				
20	6.818	4.091	2.455	4.455
40	7.429	4.857	5.714	6 000
60	6.538	4.000	5.462	5.333
AA				
AVE	6.839	4.226	4.452	5.172

Mean of Detection Flavor=Sour

	PERIOD			PP
	1	2	3	AVE
AGE				
20	37.424	12.182	4.000	17.869
40	9.762	8.000	6.857	8.206
60	121.185	27.614	35.769	61.523
AA				
AVE	66.303	17.709	17.968	33.993

Mean of Recognition Flavor=Sour

	PERIOD			PP
	1	2	3	AVE
AGE				
20	1.323	1.134	0.756	1.071
40	1.814	1.485	1.683	1.661
60	1.600	1.240	1.226	1.355
AA				
AVE	1.550	1.258	1.163	1.323

Mean of Log Detection Flavor=Sour

	PERIOD			PP
	1	2	3	AVE
AGE				
20	2.556	1.953	1.260	1.923
40	2.207	1.881	1.881	1.990
60	3.073	2.647	2.184	2.635
AA				
AVE	2.694	2.228	1.788	2.237

Mean of Log Recognition Flavor=Sour

	PERIOD			PP
	1	2	3	AVE
AGE				
20	163.636	174.545	147.273	161.818
40	183.571	291.429	205.714	226.905
60	216.923	253.077	309.231	259.744
AA				
AVE	190.484	233.871	228.387	217.581

Mean of Detection Flavor=Sweet

	PERIOD			PP
	1	2	3	AVE
AGE				
20	272.727	218.182	182.455	224.455
40	444.286	334.286	394.286	390.952
60	452.308	674.615	396.923	507.949
AA				
AVE	386.774	435.806	320.226	380.935

Mean of Recognition Flavor=Sweet

	PERIOD			PP
	1	2	3	AVE
AGE				
20	5.002	5.066	4.866	4.978
40	5.230	5.495	5.307	5.344
60	5.132	5.372	5.408	5.304
AA				
AVE	5.108	5.291	5.193	5.197

Mean of Log Detection   Flavor=Sweet

	PERIOD			PP
	1	2	3	AVE
AGE				
20	5.452	5.354	5.132	5.312
40	5.688	5.628	5.747	5.688
60	5.876	6.212	5.677	5.922
AA				
AVE	5.683	5.776	5.499	5.653

Mean of Log Recognition   Flavor=Sweet

APPENDIX C

TURKEY SAUSAGE INSTRUMENTATION

TURKEY SAUSAGE TRAINING

SWEETNESS RANKING

YOU HAVE BEEN GIVEN THREE SAMPLES OF PEACHES. EACH SAMPLE HAS A DIFFERENT SWEETNESS LEVEL. RANK THE PEACHES FROM THE LEAST SWEET TO THE MOST SWEET. RECORD YOUR ANSWERS BELOW.

________	________	________
LEAST SWEET	MEDIUM SWEET	MOST SWEET

TEXTURE RANKING

YOU HAVE BEEN GIVEN THREE SAMPLES OF GROUND MEAT PATTIES. EACH SAMPLE HAS A DIFFERENT FAT LEVEL. (ADDED FAT MAKES GROUND MEAT MORE TENDER.) RANK THE MEAT PATTIES FROM LEAST TENDER TO MOST TENDER. RECORD YOUR ANSWERS BELOW.

________	________	________
LEAST TENDER	MEDIUN TENDER	MOST TENDER

TURKEY SAUSAGE

This is a preliminary screening to judge the texture and flavor of the sausage. You will be provided with eight samples to taste. Please judge the texture, then judge the flavor. You will rate the following attributes on a scale of 1---10, with the middle value of 5 being the best rating. Please be sure and clean your palate with crackers and water between samples.

TEXTURE

1 DRY — 5 JUICY — WET 10

1 MEALY — 5 TENDER — 10 RUBBERY

FLAVOR

1 NO SALT — 5 ENOUGH SALT — 10 TOO SALTY

1 NO PEPPER — 5 ENOUGH PEPPER — 10 TOO PEPPERY

1 TOO BLAND — 5 ENOUGH SEASONING — 10 TOO STRONG

TURKEY SAUSAGE

YOU WILL BE PRESENTED WITH SEVERAL SAMPLES OF A GROUND TURKEY PRODUCT. YOU WILL BE PROVIDED A CONTOL SAMPLE WITHOUT SEASONING AS A REFERENCE. YOU ARE TO INDICATE WHICH LEVEL OF SEASONING YOU PREFER BY PLACING A CIRCLE AROUND THE SAMPLE NUMBER. CHOOSE ONLY ONE SAMPLE FROM EACH GROUP. YOU WILL ALSO PLACE A CHECK ON THE LINE NEXT TO THE TERM THAT MOST NEARLY DESCRIBES YOUR OPINION OF THE TENDERNESS AND JUICINESS OF THE SAMPLE YOU CHOSE.

TEST 1

SAMPLE NUMBER: 59 37 83

TENDERNESS

(1) EXTREMELY TENDER ______

(2) TENDER ______

(3) NEITHER TENDER NOR TOUGH ______

(4) TOUGH ______

(5) EXTREMELY TOUGH ______

JUICINESS

(1) EXTREMELY JUICY ______

(2) JUICY ______

(3) NEITHER JUICY NOR DRY ______

(4) DRY ______

(5) EXTEMELY DRY ______

CAN YOU IDENTIFY THE SEASONING________________

REFERENCE-PREFERENCE TEST

TURKEY SAUSAGE SAMPLE__________

PLEASE COMPARE THE CODED SAMPLE DIRECTLY TO THE "REFERENCE" SAMPLE. CHECK THE STATEMENT WHICH BEST DESCRIBES YOUR OPINION OF THE SAMPLE AND HOW IT RATES AGAINST THE "REFERENCE"SAMPLE.

	TENDERNESS	JUICINESS	OVER-ALL
5. VERY MUCH BETTER			
4. SLIGHTLY BETTER			
3. NEITHER BETTER NOR POORER			
2. SLIGHTLY POORER			
1. VERY MUCH POORER			

SEASONING RATINGS-RATE THE INTENSITY OF EACH INDIVIDUAL SEASONING AS YOU PERCEIVE IT IN THE SAMPLE. REMEMBER ALL FOUR SEASONINGS A PRESENT.

SALT: NO SALT — ENOUGH SALT — TOO MUCH

PEPPER: NO PEPPER — ENOUGH PEPPER — TOO MUCH

SAGE: NO SAGE — ENOUGH SAGE — TOO MUCH

CHILI PWDR.: NO CHILI — ENOUGH CHILI — TOO MUCH

OVER-ALL: TOO BLAND — ENOUGH SEASONING — TOO STRONG

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