TRAINING A FLAVOR PROFILE PANEL

By

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CHAPTER I

INTRODUCTION

"The flavor of food is composed of relatively few recognizable factors (or chemicals) plus a complex of unrecognizable factors--all of which contribute to its flavor identity" (5, p. 66). Sensory evaluation, such as the flavor profile, may be done to detect the flavor of foods. "Flavor detection is the result of chemical stimuli emitted by foods and other materials to the end organs of taste, smell and feeling in both the mouth and nose" (5, p. 66).

The flavor profile, a method of qualitative description of flavor and aroma, was "founded on the natural process of evaluating and comparing flavors by describing their impressions--either as a whole or by individual characteristics" (1, p. 377). Flavor profiles provide integrated information about flavor--not only distinguishing differences but actually "indicating the nature of flavor differences" (9, p. 17). The flavor profile has proven to be "an objective method for measuring and describing flavor" (9, p. 18).

Sensory testing may be done for several reasons: new product development, product improvement, process improve-

ment, cost reduction, selection of new supply sources, quality maintenance, storage stability or product grading (14).

In the fall of 1976, the Department of Food, Nutrition and Institution Administration was funded to do research on mechanically deboned meat. One facet of the research project was to be recipe development and then, ultimately, the testing of consumer acceptance of the recipes developed. The recipe development phase of the research pointed out the need for a trained taste panel to increase the speed and efficiency of the recipe development.

Also, in looking ahead to future departmental research, the trained taste panel could be an invaluable asset. There would be the possibility of using the trained taste panel, on a consultation basis, with other research projects on campus such as poultry, dairy or beef product development.

Purpose of Research

The purpose of this study was to train a taste panel to be proficient in the Flavor Profile approach to the measurement and analysis of flavor and odor.

Objectives of the Research

The objectives of this research were:

1. To select and train a flavor profile panel to be consistent in profiling food products, particularly beef.
2. To determine the repeatability of the product profiles.

3. To make suggestions and recommendations for continuation of the trained flavor profile panel.

Hypotheses of Research

The following hypotheses were examined:

1. There is no significant difference between the intensity of different character notes within a product.
2. There is no significant difference in the panel's day-to-day evaluation of intensity in a given character note within a product.

Definition of Terms

After-Taste-- the experience which, under certain conditions, follows the removal of a taste stimulus; it may be continuous with the primary experience or may follow as a different quality after a period, during which swallowing, saliva, dilution and other influences may have affected the stimulus substance (14, p. 28).

Aroma-- a distinctive characteristic suggestive of fragrance or odor (14, p. 29).

Bitter-- a quality of taste sensation, the taste of quinine sulfate being a typical example. Perceived by the circumvallate papillae at the back of the tongue (14, p. 29).

Character Notes-- perceptible factors defined in descriptive or associative terms.

Contrast Effect--a judgmental phenomenon which appears in evaluating food samples of different preference (or quality) levels where the presentation of one sample tends to make a following sample of the opposite quality rate either higher or lower than they would if they had been rated independently (14, p. 29).

Discrimination--1. perception of difference between two or more objects in respect to certain characteristics; 2. a differential response to two stimuli which differ quantitatively or qualitatively (14, p. 29).

Flavor--1. a mingled but unitary experience which includes sensations of taste, smell and pressure, and often other cutaneous sensations such as warmth, cold, or mild pain; 2. an attribute of foods, beverages and seasonings resulting from the stimulation of those senses which are grouped together at the entrance to the alimentary and respiratory tracts--especially odor and taste (14, p. 29).

The Flavor Profile Technique--a method of qualitative description analysis of aroma and flavor. The method makes it possible to indicate degrees of difference between two samples on the basis of individual character notes, and the degree of blending, and the over-all impression of the product (14, p. 29).

Intensity--degree to which a character note is perceived.

Odor--sensation due to stimulation of the olfactory receptors in the nasal cavity by gaseous material (14, p. 30).

Panel--a group of people (observers, subjects, judges) comprising a test population which has been specially selected or designated in some manner, e.g., they may be trained, or have special knowledge or skills, or may merely be available and predesignated (14, p. 30).

Salty--a quality of taste sensation of which the taste of sodium chloride is the typical example (14, p. 29).

Sensory--pertaining to the action of the sense organs (14, p. 29).

Order of Perception--order in which perceptible factors are perceived.

Amplitude--initial overall impression of a flavor or odor (17, p. 3).

Sour--a quality of taste sensation of which the taste of acid is the typical example (14, p. 30).

Standard--a sample presented as a model or example. The standard sample conforms to a specified level or degree of quality (14, p. 30).

Subliminal--below the threshold (applied to stimuli which are not sufficiently intense to arouse definite sensations, but which, nevertheless, have some effect upon the responses of the individual) (14, p. 31).

Sweet--a quality of taste sensation of which the taste of sucrose is the typical example (14, p. 31).

Taste--one of the senses, the receptors for which are located in the mouth and are activated by a large variety of different compounds in solution. Most investigators usually limit gustatory qualities to four: saline, sweet, sour, bitter. Distinguished from flavor, the experience to which taste contributes (14, p. 31).

Threshold or Limen--a statistically determined point on the stimulus scale at which occurs a transition in a series of sensations or judgments. Thresholds are of three kinds: 1. the threshold of sensation, stimulus threshold, or absolute threshold, often designated as RL, is the magnitude of stimulus at which a transition occurs from no sensation to sensation. 2. The difference threshold is the least amount of change of a given stimulus necessary to produce a noticeable change in sensation. It is often designated as the DL, and the interval or unit as the j.n.d. (just noticeable difference). 3. The terminal threshold is that magnitude of stimulus above which there is no increase in the perceived intensity of the appropriate quality for the stimulus (14, p. 31).

CHAPTER II

REVIEW OF LITERATURE

This chapter is devoted to a review of literature concerning flavor profile panels and how to train the panel. Any organization or institution that plans to implement a flavor profile panel must thoroughly understand the flavor profile method of sensory evaluation. The literature reviewed pertains to the flavor profile method of sensory testing, selecting, screening and training of panel members and physical requirements for sensory testing.

Flavor Profile Method of Sensory Testing

The flavor profile is one type of sensory testing. The flavor profile is empirically based which means that the method is "developed and learned through experience" (17, p. 1).

"The flavor profile was founded on the natural process of evaluating and comparing flavors by describing their impressions--either as a whole or by individual characteristics" (16, p. 1). The purpose of the flavor profile is "to record analysis in which all flavor components can be considered in perspective" (1, p. 377).

The flavor profile method was developed and initiated

in 1947 and "has proved a most effective guide to creative flavor development in that it supplies day-to-day guides toward a given objective in the construction or building of good flavor" (5, p. 65).

The flavor profile panel consists of four to six people trained in the profile method (10) (16). Panel members individually examine the product under consideration and then the panel members discuss their findings as a group. Following the discussion, a concise product description can be written which combines the panel members' conclusions (1) (16) (17).

The flavor profile works like this:

> The profile technique considers the over-all flavor and the detectable flavor components. Findings are expressed qualitatively in descriptive terms with an estimation of degrees of intensity and amplitude. Thus, the profile method of analysis is a descriptive method which takes into consideration the total impression of flavor factors according to type, intensity and order of perception (5, p. 67).

A profile tabulation gives aroma and flavor findings separately in terms of 1. perceptible factors, 2. intensity of factors, 3. order in which factor was perceived, 4. aftertaste and 5. overall impression (5).

The repeatability of panel results "is generally based upon the skill of it's practitioners carefully monitoring each other's performance, and employing objective reference standards to eliminate discrepancies" (17, p. 1). This reproducibility is cited to be one major advantage of the flavor profile. Identical profiles for soup done a year

apart exemplify the reproducibility of the flavor profile (1).

Several disadvantages of the flavor profile have been found: 1. the training and conducting of flavor profile panels is time-consuming and, thus, expensive, 2. individual responses to flavor can not be quantified, 3. a three-point intensity scale lacks precision, and 4. there is a potential danger in using only open discussion techniques (1).

Selection of Panel Members

One of the most important factors for panel member selection would be interest in participating in sensory testing (9) (12). In fact, "obtaining useful results depends heavily on maintaining a satisfactory level of motivation" (12, p. 8). While there is no easy way to increase motivation, the experimenter needs to be aware of the importance of maintaining motivation and interest in the project.

Availability for sensory testing is another factor to consider. The best time for sensory testing is 10:00 to 11:00 a.m. and 3:00 to 4:00 p.m. (9). Panelists need to be available at those times and thus people who travel or have demanding schedules would not be satisfactory panelists.

Panelists should have the ability to taste and smell. People who have taste- or smell-blindness or have extremely high thresholds would be of no value on a flavor profile panel (9).

Panelists should be able to produce reliable and

consistent results. A good memory and experience will contribute to precision.

Panelists should be intelligent and able to work with others. Panel members should work together--dominant, and also very quiet types who would be uncomfortable working with others, should not be selected.

Age, sex or smoking habits need not be considered (9) (10). Earlier literature indicated panelists should be twenty to fifty years old (1).

Good health is essential to panelists. People who are overly susceptible to sinus conditions and head colds would not be wise panel choices (1) (9). General good health and freedom from physical fatigue and worry are necessary.

It has been suggested that panel candidates fill out a questionnaire concerning:

> experience, availability, age, sex, health, smoking habits, quantity of foods habitually consumed, food prejudices and asthmatic, physiocardiac and respiratory conditions (1, p. 282).

While much of this information will be of little value, some general suggestions should be followed when the panel is conducted:

1. Do not test for one hour after meals.
2. Wait at least twenty minutes after smoking, chewing gum or eating or drinking.
3. Do not use panel members who are ill, particularly when suffering from the common cold.
4. Encourage panel members to avoid eating highly spiced foods for lunch on days tests are to be run in the afternoon.
5. When running odor tests, ask panel members not to use such cosmetics as perfumed face lotions or lipstick. It is desirable to have subjects wash their hands with odorless soap when they

are required to handle the containers.
6. In taste testing, as a precautionary measure have subjects rinse out their mouths with water just prior to starting a test (12, p. 9).

In order to obtain panelists with the qualities to perform well as a flavor panelist, a screening process should be conducted. A single screening seems to be insufficient for panel member selection. Further screening would produce a better panel (1).

The screening process should include specific tests based on:

1. discriminating differences between solutions or substances of known chemical composition;
2. ability to recognize flavors and odors;
3. performance in comparison with other panel members, and
4. ability to discriminate differences in samples to be used later in the test (1, p. 281).

Screening tests include both flavor and odor (1) (9) (13). One basic test used in screening is the basic tastes test (1) (9) (13). This test would determine the individual's ability to differentiate the four basic tastes--sweet, salt, sour and bitter. These tastes are determined by the use of above-threshold concentrations of sucrose, salt, citric acid and quinine sulfate in solution. It is not necessary to determine the individual's threshold to the four basic tastes but Martin suggests it would certainly be of value (13).

Ranking is another type of screening test generally done (13) (16). Ranking is generally done with sugar solutions. Any number of solution intensities may be used. Martin suggests the use of three intensities of sugar solution (13). The average individual can readily identify a fifty per cent

increase in flavor intensity while more perceptive individuals can detect a twenty per cent increase (15).

Odor tests are also a part of the screening process. This test generally includes twenty odorants (1) (9) (13) (16). When testing for odor, panelists should take quick sniffs to get the odor high up into the nose. Gentle sniffs allow a deflection of the odor (4). The following eight odor standards have been suggested for use in odor recognition tests:

1. Oil of cade (juniper tar--burnt odor)
2. Cassia (cinnamon)
3. Eucalyptus
4. Amyl acetate (banana)
5. Clove oil
6. Orange oil
7. Almond oil (benzaldehyde)
8. Vanillin or vanilla extract (7)

Generally the individual is not required to be able to correctly identify the odors, but rather, be able to describe them. The use of a description technique is indicative of the individual's ability to communicate that which he has perceived. This test might also be useful to show the individual's interest in flavor panel participation (16).

A second odor test, the odor threshold test, is sometimes used (1) (16) to determine "the candidate's olfactory acuity in terms of a measured amount of odorized air" (16, p. 10).

Following taste and odor tests, personal interviews are used to determine interest, availability and personality characteristics (13) (16).

Training of Flavor Panelists

Training is important but the amount depends on the acuity expected of the panelists. Training can be defined as "steps which may be taken deliberately to increase the effectiveness and the rate at which the individual assimilates new knowledge or new techniques" (1, p. 295).

Training for the flavor profile has many purposes:

> Training increases sensory acuity; makes certain that the panel has uniform understanding of the properties to be evaluated, the system of evaluation and the relationship between quality or intensity of sensory stimuli; and minimizes the effects of irrelevant factors (9, p. 12).

In addition, training helps familiarize panelists with a laboratory-type situation, helps panelists overcome personal preferences and biases, teaches the recognition of small differences and helps obtain greater homogeneity of response and more consistent results (1).

Training can also be of great importance in developing a uniform understanding of particular properties, obtaining agreement among panelists on descriptive terms and the assignment of a score to the descriptive term (1). Amerine also suggests that training helps panelists "learn to compare flavors and flavor strengths in spite of a time lag between samples" (1, p. 296).

Training actually begins during the screening process (1) (9) (10). During the screening process, participants are becoming cognizant of flavors and odors and are developing a descriptive nomenclature as well.

Panelists need training in two ways: "1. in the method of testing and general examination technique, and 2. in the specific product to be tested (including off-flavors to be expected)" (9, p. 12). Experience can best accomplish the first. Dilution tests are often used to train panelists in flavor character if a single flavor predominates. Panelists need to be able to recognize the flavor and correctly estimate the intensity of the flavor. The flavor is diluted and the panelist can react to a lessened intensity.

Often off flavors and odors exist. If there is no standard, these off flavors and odors may be difficult to detect. In this case, extensive training will be needed for detection (9).

Training usually involves a one-to two-week intensive course on the basics of the flavor profile method. This would include the use of sample products for initial trials (13). Training should be timed so that upon completion of training the test product would be available for flavor profile. Panelists should have refresher training when a particular product to be profiled has not been tasted for some time (9).

In summary, the following points have been recommeded for consideration:

1. Train panel members on the products to be tested.
2. Give panel members enough information about the test to stimulate their interest and to let them know what is expected of them.
3. Stimulate additional interest by having testers participate in setting up the score sheet.
4. Keep the score sheet simple!
5. Supply reference samples whenever possible.
6. Allow members to compare their scores with those of experienced panels (after completion of the test).
7. Keep members informed as to the results of tests and their effect on the project.
8. Don't discard testers if they fail on one product--they may be 'experts' on another. Judges incapable of judging one product may be suitable for judging other products.
9. Treat training as a continuous process with refresher training courses whenever the panel falls out of line (9, p. 12).

Physical Requirements for Sensory Testing

For sensory testing, panel members are used as measuring instruments--quite similar to the use of an intricate machine. To obtain consistent results "every effort must be made to control the effect of the environment on judgment" (11, p. 28).

In the effort to maintain an optimal setting, it is necessary to include the "control of irrelevant odor stimulation, elimination of psychological distraction, and provision of a generally comfortable work environment" (12, p. 1). Again, the aim of this type of setting is unbiased judgements on the part of the panelists.

Location

The testing area should be conveniently located so that it can be reached easily while at the same time being free of extraneous disruptions. The normal work routine should

remain as uninterrupted as possible to keep performance as high as possible. Therefore, it is best to locate the area where traffic is as light as possible.

The testing area should be kept comfortable. Air conditioning is recommended (9) (10) (11). In cases of extremes in humidity, it is desirable to control humidity (11).

The testing area should be free of food and other odor. Smoking should not be permitted and cosmetic and perfume odors should be avoided in the testing area (11). As mentioned earlier, panelists should refrain from smoking at least twenty minutes before tasting and panelists should not use cosmetics and perfumed soap on the testing day (12). The American Society for Testing and Materials recommends maintenance of a slight positive pressure within the testing room to inhibit odors from entering the area (12).

Another method of controlling odors would be the use of activated carbon filters in the air conditioner (12). Equipment and materials in the room should be as odor free as possible. If highly odoriferous samples are to be used, they should be exposed for the shortest time possible (12).

In addition, the preparation and testing area should be kept separate both to avoid odors and also to avoid biases the panelist might develop if sample preparation is seen. The preparation room should be close and easily accessible to the testing area.

Testing Set-Up

For flavor profiling it is necessary for individual product evaluation by each panelist and then a discussion among all flavor profile panel members. For individual evaluation, booths or partitions are needed.

Booths for individual evaluation can be elaborate or simple depending on the amount of use and the funds available. A more elaborate setting might include booths constructed along the wall dividing the preparation room from the serving room. Samples could be served from the preparation room directly to the booths. A signal system is devised and could be a light which would signal the preparation room personnel that the taster is ready for another sample (11).

When funds are not available, a simpler method could be used. Collapsible, hinged partitions could be used in the middle of a round table and then removed after individual evaluations are completed (11).

For flavor profiling, a round table is essential to permit discussions. A moveable center, such as a lazy Susan, is helpful in passing standards and samples back and forth (11).

The booths or panels should be a color that would not influence the evaluation of the product. An off-white or light to neutral gray is usually recommended (9) (11).

An atmosphere of comfort and relaxation is needed in the testing room. Both at tables and individual booths, care should be given to provide comfortable chairs or

stools (11) (12).

Panelists should be allowed adequate time to develop their product profiles. No time limits should be imposed nor should they feel hurried at any time (2).

Lighting

In general, lighting should be adequate and uniform for all booths or areas of the testing room. Fluorescent or natural lighting is considered adequate (9). Care must be taken in selecting lighting as "white" lights may distort color (11).

For the elimination of color differences, special lighting may be used. This could involve the use of colored (red, yellow, etc.) lighting or dimmed lighting. If colored lighting is used, differences in color intensity can still be detected (11).

Sample Preparation

As mentioned earlier, facilities apart from the testing area are needed for sample preparation. The kitchen should be well equipped. Equipment needs will depend on the products to be tested. The kitchen area should be well ventilated.

Sample preparation often requires much preparation room. As much space as possible should be allowed. Adequate counter space is needed for assembling of serving dishes. The counter and surface areas should be hard, durable and easily cleaned. Wooden surfaces are not recommended because

they are difficult to clean, stain easily and are difficult to thoroughly sanitize.

The preparation room should be equipped with an automatic dishwasher capable of rinsing dishes with water of 180° F if possible. The dishwasher is necessary from the standpoint of time and sanitation. The kitchen should meet the same basic requirements of the State Health Department for public eating places. The regulations do permit the use of a three-vat sink with the use of sanitizing agents to replace an automatic dishwasher. This would fulfill health requirements but would be a more time-consuming method of clean-up.

Electrical equipment is usually recommended for the preparation room. Electrical equipment is preferred because the temperature is more closely controlled and because of the gas odors which may occur with the use of gas equipment (9).

Before testing is done, the specifics of the preparation of the product to be tested should be considered and should be a method which does not impart any foreign or unusual flavor or odor to the product. Foods in their normal state are generally preferred by the taster (11).

While foods are preferred in their normal state, it is often necessary to slice, dice, puree, etc. to make products uniform. It has been found that panelists are influenced by irrelevant characteristics of samples (11).

Dilution and Carriers

Foods should be served as they are normally consumed. Some foods might need to be diluted if they are concentrated in flavor. Some products will necessitate the use of a carrier. An example would be pie crust. To evaluate the quality of the crust, it is necessary to use filling to see if the crust becomes soggy (11). Carriers can be used but carriers add to the cost and may present a problem in selection of a satisfactory carrier (11).

Utensils

Utensils used for serving should be a type which would not impart foreign flavors or odors to the product and should be reserved for panel use only.

Containers should be identical for all samples (11). The containers should be colorless or white unless color differences need to be masked.

Utensils should be made of glass or stainless steel for ease of cleaning and because they do not impart an odor or flavor. Compounds used for cleaning should not impart an odor or leave a residue on the utensils.

Paper, styrofoam or plastic dishes can be used for very large groups of people such as consumer testing. These products would speed clean-up time considerably but often impart off flavors and odors to the product and taster (9)(11).

A recommended list of utensils for a laboratory includes:

ruby red glasses, barrel shaped preferred (3 ounce)

custard type pyrex glass dishes (6 ounce)
institutional type demi-tasse cups (3 ounce)
small stainless steel forks
small stainless steel spoons
glass snifters (8 or 12 ounce)
glass stoppered bottles for odor tests (4 or 8 ounces)
watch crystals
5½ inch thermometers, 0 to 220° F range (9, p. 4)

Serving Temperatures

Foods for sensory evaluation are generally served at the temperature they are normally served (11) (12). Hot foods should be served hot and cold foods should be served cold but extremes should be avoided (12). Hot foods are usually served at 140-150° F (11) but not above 170° F (12). Cold foods should not be served below 45° F (12) and usually not above 50° F (11). Larmond suggests ice cream be served at 30-35° F (11).

Regardless of the temperature selected for serving, the same temperature should be used throughout the testing of the product. The serving temperature must be maintained from the preparation to the serving. Temperature maintenance can be obtained through a variety of methods including warming ovens with controlled temperature and humidity, hot water baths, electrically heated beakers or blocks of styrofoam to act as an insulator (11). The aim in holding foods for any length of time would be to prevent dryness and a change in the quality of the product.

Table I shows temperature recommendations for testing various products (6, p. 26).

TABLE I

TEMPERATURES RECOMMENDED AS OPTIMUM FOR TASTE-TESTING VARIOUS PRODUCTS(6)

Product	Aroma °F	Flavor °F
Beer	40	42
Bread	72	72
Butter	72	72
Carbonated Beverage	45-50	45-50
Coffee	160	155
Distilled Liquors	72	72
Edible oils	110	110
Hot Foods	150	150
Ice Cream	30-35	30-35
Mayonnaise	72	72
Milk	45	45
Soups	160	160
Tea	160	155
Water	72	72
Wines	72 or chilled	72 or chilled

Sample Size

The sizes of samples may vary quite a lot but upper limits are often determined by the amount of preparation required and the amount of materials available. Normal sized servings are not required. Usually about ½ ounce liquid and one ounce solid is enough for discrimination testing and that amount should be doubled for preference testing (12).

The serving sizes should, however, be consistent throughout the testing period. Servings should be large enough that the panelist can taste until a decision is made.

It is sometimes necessary to require the taster to

taste larger sized samples. Some workers have found that small samples are pleasing but larger servings may be too sweet, too salty, etc. (11).

Sample Coding

Samples must be coded so that the researcher knows what the samples are but not giving any information to the panel members. Some codes are suggestive and give the panel members a bias. Codes such as 1, 2, 3, 4 or A, B, C, D suggests a particular order and should be avoided. The letters K, L, P, T, R and S seem to give no connotation of order (9).

A two-, three-, four- or five-digit coding system of numbers could be used where differences are small. The numbers can be generated from a table of random numbers such as the one on Table II. When properly used, no bias is indicated (9). In the Manual on Sensory Testing Methods, the following recommendations on coding are made:

1. Use two- or three-digit codes generated from a table of random numbers.
2. Use multiple codes for a sample even in the course of a single session.
3. Avoid the temptation to use a certain code, or set of codes, constantly to expedite tabulation of results (12, p. 11).

Order of Presentation

When more than one sample is involved in a test, the order of presentation may have an influence on the outcome. The "contrast effect" results when a poor sample is followed

TABLE II

FIVE DIGIT SAMPLE CODE NUMBERS

Use all, or part, of any one series, depending upon the number of samples. Do not mix series (9, p. 9).			
67502	42651	86942	92638
63247	46038	89754	94103
60815	49827	81037	97052
64191	47985	82516	95347
69328	45319	85370	98461
65470	41076	84963	96785
59204	76304	48613	86429
56039	71925	42368	82063
53792	79682	43980	87590
58176	78436	40759	84317
54687	74591	47526	81946
57948	75813	45291	83275
91437	51863	72864	67529
96852	52098	74596	68954
98576	57302	70315	64301
92041	54671	79680	61580
94623	56749	73921	67892
94708	53984	71538	63407

by a good sample, the good sample receives a higher rating. A good sample followed by a poor sample would result in the poor sample getting an even poorer rating (11).

Another effect of order is referred to as the "convergence effect". This means that products evaluated together tend to be evaluated similarly regardless of existing differences.

Some tests produce a positional bias. In the triangle test, there is a tendency to select the middle sample as the odd sample (2) (11).

Position effect is usually present but is highly variable. Contrast effect is usually found and is larger

than and independent of the positional effect. Convergence effect has been shown to be independent of positional effect but is thought to be of little use in practice (8).

To avoid position or order of presentation biases, the orders of samples are randomized or balanced. This would assure that every combination would occur at an equal number of times (11).

Rinsing

Rinsing the mouth is often done between product samples. The water should be neutral in taste and should be at room temperature. Water above body temperature is advised for trained panels tasting fatty foods.

"Rinsing between samples is not done universally" (12, p. 10). Panelists are usually given their preference but are encouraged to be consistent throughout testing.

CHAPTER III

PROCEDURES

The purpose of this chapter was to identify the procedure for selecting and training a flavor profile panel and the method of determining the repeatability of the panel.

Selection of Panel Members

Twenty people who were interested in participation on a trained taste panel were recruited. Sources of interested people were graduate students in foods and nutrition, former peanut panel members and home economics faculty members.

An orientation was held for potential panelists. During this orientation, an introduction to the flavor panel and panel procedures were given as well as times the panel would meet. Time schedules prevented several potential panelists from participating.

Seven persons were recruited from this group. One odor and two taste tests were given to these prospective panelists. The first taste test was basic tastes. This test measures only the person's ability to differentiate between the four basic tastes (sweet, sour, salty and bitter) by tasting four solutions prepared for this purpose. The four basic taste solutions were at above-threshold concentrations of 2% sucrose,

1% salt, .5% citric acid and .25% quinine sulfate. Each individual was to taste the solutions and simply identify the basic taste.

The second taste test was a ranking test and included one set of four samples of 1%, 2%, 3% and 4% sucrose solutions. Each individual was to taste each solution and order them from high to low in concentration. This ranking test measured the person's ability to differentiate among varying cencentration levels.

An odor identification test was given to participants with fifteen odors including: amyl acetate, coconut, oil of nutmeg, oil of sassafras, black walnut, clove oil, orange oil, cassia oil, anise oil, peppermint oil, pineapple, lemon oil, wintergreen oil, mint and vanilla. Odor samples were prepared in small, tightly covered brown bottles containing cotton onto which two to three drops of the oil or extract was placed. Each panelist was to smell the sample and either identify or describe the odor. A discussion followed as well as a re-evaluation of odors which were not identified by panelists. Cards were kept with data on each individual and the results of the tests were recorded along with observations of the researcher in regard to apparent interest and motivation.

During the screening process, participants were questioned as to time schedules, smoking habits, allergies, sinus conditions, health and types of foods normally consumed. All seven candidates began the training process and one

dropped out after the second week.

Training of Panel Members

A more detailed orientation was given the six persons who continued training. More details about methods and scales to be used were explained. The six panelists included a statistician, a university instructor in the area of family relations and child development, a dietetic intern, a secretary, a graduate student in nutrition and a dietitian.

During the training, the goal was to develop the panelist's sensitivity to flavor, odor, methodology and nomenclature by profiling the following foods:

a. Apple juice

b. V-8 juice

c. Bakery bread

d. Beef patties

e. Beef patty containing 20% mechanically deboned beef The mechanically deboned beef was obtained from the Beehive Machinery Company in Sandy, Utah.

The panel met at 2:00 p.m. Two product evaluations were completed at each meeting. Panelists were provided with distilled water to rinse the mouth between samples. It was the choice of the individual whether to rinse but they were asked to be consistent. All panelists did choose to rinse between samples.

Method for Recording Profile

Panelists were given product evaluation forms with a series of 15 centimeter scales indicating intensity from weak to strong (see Appendix A). Beside each scale, panelists were to record the character notes or characteristics in the order the notes were perceived and then mark the scale with the intensity of the character note. A separate evaluation form was used for each of the three times the products were evaluated. A discussion among panelists then took place.

The researcher assigned numerical values to the intensity scales by measuring the scale in centimeters--zero being the weakest and 15 being the strongest intensity for any character note. Results of each panelist's profile were recorded by the researcher on a composite sheet (see Appendix B).

Analysis of Data

Following collection of product profiles, the Friedman test for multiple observations per sampling unit and the Chi square distribution were used to test the hypotheses (see Appendixes C and D).

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to select and train a flavor profile panel who would be proficient in product evaluation. To do this, a sensory evaluation laboratory was established and a panel, consisting of six members was selected and trained. Potential panelists were screened and product profiles of five different products were done three times each. Panelists were absent from some testing times so data were only used if panelists were present all three times.

During the screening process a basic taste test, ordering of four intensities of sucrose solutions and an odor identification test were given. The samples were coded with three-digit random numbers.

All six panelists correctly identified the four basic tastes solutions--sweet, salty, sour and bitter. Solutions were at above threshold concentrations.

Four concentrations of sucrose solutions--1%, 2%, 3% and 4%, were used to order intensities. All six panelists were able to order these solutions from high to low.

Fifteen odors were used for the odor identification test. Most odors were common. Panelists were asked to identify or

describe the odor. Of five panelists taking the odor test, two correctly identified four of 15 odors or 26% of the odors. Two panelists correctly identified seven of 15 or 44% of the odors. One panelist correctly identified nine of 15 or 60% of the odors. While not being able to name the odor, panelists could often describe it or identify a familiar product that contained the odor.

Product evaluations were done for apple juice, V-8 juice, bread, beef patties and mechanically deboned beef patties (20% mechanically deboned beef and 80% regular ground beef). A fifteen centimeter scale was used--panelists identified the character note and marked the intensity on the scale. From these data, the following hypotheses were tested:

1. There is no significant difference between the intensity of different character notes within a product.
2. There is no significant difference in the panel's day-to-day evaluation of intensity in a given character note within a product.

Using the Friedman test for multiple observations per sampling unit and the chi square distribution a significant difference was found in the intensity of character notes within all five products tested (see Table III). As a result, the first hypothesis would be rejected. This verifies that several character notes within a product can be evaluated independently and panelists can discriminate

between the intensity of a given character note.

TABLE III

CHARACTER NOTE INTENSITY*

Product	χ^2_r	χ^2_{tab}
V-8 Juice	33.0168	9.488
Apple Juice	13.1704	5.991
Bread	22.0000	9.488
Beef Patty	10.2948	9.488
Mechanically Deboned Beef	27.9187	7.815

*The Friedman test was applied to product evaluation data (see Appendix C) and compared with chi square values at the 0.05 level of significance.

The Friedman test and chi square distribution indicated that the second hypothesis would be rejected. The panel did show repeatability indicating no significant difference in product evaluations (see Table IV).

TABLE IV

PRODUCT PROFILE REPEATABILITY*

Product	χ^2_r
V-8 Juice	
Tomato	.333
Salt	2.583
Celery	.333
Other	4.000
Apple Juice	
Apple	5.333
Sweet	3.250
Tart	0.083

TABLE IV (Continued)

Product	X_r^2
Bread	
Salt	5.250
Doughy	4.750
Flour	4.333
Sweet	0.750
Other	1.333
Beef Patty	
Beefy	2.625
Salt	0.375
Chewiness	2.375
Other	0.500
Mechanically Deboned Beef Patty	
Beefy	0.500
Grainy	0.500
Salt	0.125
Aftertaste	1.500
Other	1.625

*Intensity of character notes (see Appendix B) derived from panel product evaluations, were analyzed using the Friedman test (see Appendix D). Calculated values were compared with the chi square value at the 0.05 level of significance or 5.991.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

Summary

The results of data collected from flavor profiles of five products repeated three times each are presented. This research was conducted to train a flavor profile panel to do sensory evaluation of food products for recipe development. The objectives were: 1) to select and train a flavor profile panel to be consistent in profiling food products, particularly meat, 2) to determine the repeatability of the product profiles, and 3) to make suggestions and recommendations for continuation of the trained flavor profile panel.

Data were collected from six panel members. The data were analyzed using the Friedman test for multiple observations per sampling unit and the chi square distribution to test the repeatability of the flavor profile panel. The researcher concluded that the panel profiles for the five products tested are repeatable. If long time lapses occurred between training and the use of the panel for recipe development or product profiling, refresher training should be given.

The panel also was found to give different intensity

values for the various character notes in the profile of each particular product. The panel seemed to evaluate each character note independently.

Recommendations

The tool used by the panelists to record product profiles needs to be revised (see Appendix A). The first time the panel tries a product the tool can be left as is without character notes to allow panelists to think about the product and describe the product as they see it. Individual evaluations should be followed by a discussion of the product by the panel and they, as a whole, should develop a common set of terms or character notes that will be used for following profiles of that particular product. These character notes should be printed on the evaluation form to the left of the scale so that all panelists will use a common nomenclature and thus, facilitate statistical analysis. Evaluations should be made at least three times after the common character notes are decided upon. The 15 centimeter scale should continue to be used.

For further sensory evaluation it is recommended that work be done to improve the room arrangement. Excess furniture should be removed and replaced with a round table (large enough for all panelists to sit comfortably) for discussion.

Temperatures of both the room and the products need to be better controlled. The room was somewhat drafty in the

booth area causing the food products to cool rapidly. The use of a small thermometer to derive internal temperature and perhaps the use of warming plates are advised for products where temperature control is especially necessary as is the case with meat.

Further studies could be done with a flavor profile panel on recipe and new product development for any number of products. If the present panel was used, refresher training would need to be given and if a new panel must be established, a screening and training period would need to be conducted. The flavor profile panel could be utilized for joint projects with dairy science in product and procedure development, with meat science to compare feeding methods of specific animals or to develop procedures or with agronomy to determine the flavor of different varieties of grains, peanuts or other crops.

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APPENDIXES

APPENDIX A

SENSORY EVALUATION TOOL

SENSORY EVALUATION TOOL*

Name _____

Date _____

Product _____

Character Note	Intensity
_____	weak ——— strong
_____	weak ——— strong
_____	weak ——— strong
_____	weak ——— strong
_____	weak ——— strong
_____	weak ——— strong
_____	weak ——— strong
_____	weak ——— strong

*Example of scorecard using a 15 centimeter scale to indicate the intensity of perceived attributes or character notes derived by each panelist. Numerical values were place on intensity by measuring the scale in centimeters and assigning the corresponding value.

APPENDIX B

RESULTS OF PRODUCT PROFILES

TABLE V

INTENSITY OF CHARACTER NOTES IN V-8 JUICE*

Day	Subject A		Subject B		Subject C		Subject D		Subject E		Subject F	
1	Tomato	12.9	Tomato	5.6	Tomato	12.7	Tomato	12.4	Sour	5.5	Tomato	10.7
	Celery	10.2	Spice	3.7	Salt	8.4	Celery	8.8	Sweet	4.6	Celery	7.7
	Salt	6.3	Celery	3.6	Celery	3.1	Salt	6.4	Salty	6.8	Carrot	6.0
			Bitter	3.0					Celery	6.7	WS**	4.3
									Tomato	10.1	Salt	4.5
											Lemon	4.6
2	Tomato	12.3	Tomato	10.7	Tomato	9.4	Tomato	10.9	Tomato	8.9	Tomato	11.2
	Salt	11.0	Spice	7.3	Salt	6.2	Celery	8.6	Celery	8.8	Celery	8.7
	WS**	8.0	Bitter	3.5	Celery	5.6	Salt	7.4	Salt	9.7	Parsley	6.7
	Celery	7.3	Thick	5.1	Carrot	2.2	Bitter	8.1	Sweet	3.5	Carrot	5.1
					Sweet	1.9			Sour	4.6	Spice	4.7
											Salt	2.8
3	Tomato	12.1	Tomato	8.3	Tomato	9.9	Tomato	9.8	Tomato	8.7	Tomato	11.5
	Salt	11.8	Bitter	4.8	Celery	4.9	Salt	7.6	Celery	10.0	Sweet	9.7
	Celery	12.0	Salty	5.3	Bitter	9.5	Celery	8.2	Salty	8.3	Spice	7.3
	WS**	5.5	Spice	3.6	Carrot	4.5	Bitter	5.5	Parsley	4.6	Salt	4.8
	Carrot	2.1			Salty	5.2	Spicy	4.0	Sour	8.1	Pulp	10.5
							Viscous	5.0				

*Product evaluations repeated three times on three different days. Intensity values were derived by measuring the 15 centimeter scale and assigning a numerical value in centimeters--zero being the weakest intensity and 15 the strongest intensity possible.

**Worchestershire Sauce

TABLE VI

INTENSITY OF CHARACTER NOTES
IN APPLE JUICE*

Day	Subject A		Subject B		Subject C		Subject D		Subject E		Subject F	
1	Apple	12.3	Sweet	10.5	Apple	13.5	Fruity Sweet	7.6	Sweet	9.5	Apple	11.3
	Aftertaste	12.1	Tart	7.7	Sweet	5.6	Tart	6.5	Fruity	11.1	Sweet	6.6
	Sweet-Sour	7.3	"rough"	5.1			Apple	9.9	Tart	3.3	Water	8.5
											Spice	3.9
											Salt	3.3
											Tin	2.6
2	Apple	12.4	Sweet	7.6	Tart	2.2	Sweet	7.8	Apple	7.0	Apple	11.1
	Syrupy	7.0	Tart	4.9	Apple	11.6	Tart	7.2	Sweet	10.4	Water	9.9
	Aftertaste	11.2			Sweet	5.3	Apple Flavor	9.2	Honey	3.7	Cinnamon	5.6
							Apple Odor	9.2			Sweet	5.2
3	Apple	11.6	Sweet	7.6	Apple	10.5	Fruity Sweet	8.9	Apple	9.0	Apple	11.0
	Syrupy	10.9	Bitter	3.7	Sweet	8.3	Apple	8.7	Sweet	10.0	Water	8.7
	Sweet-Sour	12.2	Smooth	5.0			Tart	5.8	Tart	4.3	Sugar	7.0
											Cinnamon	3.1
											Salt	3.0
											Aftertaste	4.7

*Product evaluations repeated three times on three different days. Intensity values were derived by measuring the 15 centimeter scale and assigning a numerical value in centimeters--zero being the weakest intensity and 15 the strongest intensity possible.

TABLE VII

INTENSITY OF CHARACTER NOTES IN WHITE BREAD*

Day	Subject A		Subject B		Subject C		Subject D		Subject E		Subject F	
	Salt	8.5	Salty	4.1	Soft	10.2	Smooth Texture	9.8	Salt	8.4	Dough	10.0
	Spongy	9.8	Grainy	4.2	Buttery	.8	Color	11.2	Sweet	7.9	Sweet	9.3
1	Flour	3.3	Doughy	6.5	Firm Crust	5.6	Off Flavor	10.7	Stale	5.3	Milk	5.6
	Dry	6.9	Chewy Crust	5.9	Fresh	7.5	Gummy	9.9	Chewy	5.6	Salt	4.5
							Salt	7.1				
	Spongy	11.0	Cereal Grain	5.7	Tough	12.0	Doughy	7.5	Flour	7.0	Doughy	8.9
	Dry	7.1	Doughy	4.2	Dry	3.9	Flour	7.6	Chewy	9.0	Sweet	3.1
	Flour	9.6	Chewy Crust	4.3			Bland	6.1	Salty	6.8	Salt	3.6
2	Salt	3.0					Tough	8.8	Sweet	4.3		
							Dry	7.3	Stale	3.6		
	Spongy	11.8	Cereal Grain	7.1	Salty	11.1	Doughy	10.0	Wheat	7.9	Doughy	11.2
	Flour	6.6	Doughy	4.4	Doughy	4.8	Salty	8.9	Salty	9.2	Sweet	6.7
3	Salt	3.0	Chewy	4.8	Soft	9.5	Flour	9.1	Chewy	9.5	Salt	5.4
			Sweet	3.3			Tough	9.1	Soft	5.5		

*Product evaluations repeated three times on three different days. Intensity values were derived by measuring the 15 centimeter scale and assigning a numerical value in centimeters--zero being the weakest intensity and 15 the strongest intensity possible.

TABLE VIII

INTENSITY OF CHARACTER NOTES
IN BEEF PATTIES*

Day	Subject B		Subject C		Subject D		Subject E		Subject F	
	Beefy	6.4	Bland	4.6	Mushy Texture	10.2	Meaty	10.5	Dry	11.0
	Salty	4.5	Mealy	7.9	Salt	5.4	Oily	9.6	Elastic	10.0
1	Seasoning	2.9	Dry	6.0	Chewy	9.1	Salt	7.9	Beef Fat	6.4
	Grainy	8.2	Beefy	3.0	Meaty	8.0	Dry	4.4	Grainy	6.3
					Dry	9.2			Bland	11.8
									Off Flavor	3.6
	Beefy	7.0	Bland	10.2	Meaty	10.3	Meaty	7.7	Fat	7.6
	Spongy Texture	3.7	Beefy	11.6	Salt	6.5	Salt	4.9	Moist	9.7
2	Salty Aftertaste	4.0	Juicy	4.4	Chewy	9.1	Moist	10.2	Salt	4.4
	Moist	5.0	Mealy	7.8	Sticky Texture	5.8	Chewy	3.8		
	Beefy	6.7	Salt	0.5	Meaty	10.1	Beefy	7.4	Moist	11.7
	Spongy Texture	4.3	Moist	5.7	Salt	10.0	Bland	6.4	Bland	7.2
3	Salty Aftertaste	3.1	Mealy	6.6	Chewy	9.3	Chewy	8.6	Beef Fat	5.9
			Beefy	9.1	Sticky	8.4	Moist	6.6	Gristly	4.8
			Bland	4.5	Dry	4.6				

*Product evaluations repeated three times on three different days. Intensity values were derived by measuring the 15 centimeter scale and assigning a numerical value in centimeters--zero being the weakest and 15 the strongest intensity possible.

TABLE IX

INTENSITY OF CHARACTER NOTES IN MECHANICALLY DEBONED BEEF PATTIES*

Day	Subject A		Subject B		Subject D		Subject F	
	Beefy Flavor	11.1	Beefy Taste	6.1	Grainy	10.6	Beefy Flavor	8.4
	Gristle Texture	3.2	Bland	5.7	Gritty	7.8	Salt	3.9
1	Fatty Taste	3.1	Salty	2.9	Beefy Flavor	7.8	Grainy	6.0
	Salt	3.1	"sticky"	4.5	Salt	3.3	Aftertaste	5.8
					Boney Aftertaste	8.3	Dry	10.7
	Beefy Flavor	12.0	Beefy	6.3	Beefy	10.0	Dry	10.9
	Gristle Flavor	6.2	Moist	4.4	Grainy	9.9	Gristle	9.6
2	Salt	2.9	Salty Aftertaste	3.4	Smooth Texture	5.3	Sweet Beefy Flavor	7.6
	Fat	4.2	"sticky"	3.5	Boney Aftertaste	6.3	Grainy	6.2
			Sweet	2.9	Gritty	7.9	Metallic Aftertaste	3.7
	Beefy	10.5	Beefy	6.7	Smooth Texture	4.7	Gristle	8.7
3	Even Texture	11.3	Spongy Texture	3.5	Grainy-Gritty	6.8	Beefy	8.5
	Salt	3.8	Salty Aftertaste	3.0	Beefy	6.0	Moist	7.1
	Moist	9.9	Moist	3.4			Sweet	4.4

*Product evaluations repeated three times on three different days. Intensity values were derived by measuring the 15 centimeter scale and assigning a numerical value in centimeters--zero being the weakest intensity and 15 the strongest intensity possible.

APPENDIX C

METHOD FOR DETERMINING INTENSITY DIFFERENCES

TABLE X

FRIEDMAN TEST TO MEASURE INTENSITY DIFFERENCES IN V-8 JUICE

Subject	Tomato	Salt	Celery	Other
A	12.9(12)*	6.3(3)	10.2(6)	0(1)
	12.3(11)	11.0(7)	7.3(4)	8.0(5)
	12.1(10)	11.8(8)	12.0(9)	5.5(2)
B	5.6(9)	0(2)	3.6(4.5)	3.7(6)
	10.7(12)	0(2)	0(2)	7.3(10)
	8.3(11)	5.3(8)	4.8(9)	3.6(4.5)
C	12.7(12)	8.4(8)	3.1(3)	0(1)
	9.4(9)	6.2(7)	5.6(8)	8.1(6)
	9.9(11)	5.2(5)	4.9(4)	9.5(10)
D	12.4(12)	6.4(3)	8.8(9)	0(1)
	10.9(11)	7.4(4)	8.6(8)	8.1(6)
	9.8(10)	7.6(5)	8.2(7)	5.5(2)
E	10.1(12)	6.8(4)	6.7(3)	5.5(2)
	8.9(9)	9.7(10)	8.8(8)	4.6(1)
	8.7(7)	8.3(6)	10.0(11)	8.1(5)
F	10.7(10)	4.5(3)	7.7(7)	6.0(5)
	11.2(11)	2.8(2)	8.7(8)	6.7(6)
	11.5(12)	4.8(4)	0(1)	10.5(9)
	R_1 = 191	R_2 = 91	R_3 = 107.5	R_4 = 78.5

*The numbers in parentheses indicates ranking which was done within individuals. Other numbers were derived from product profiles.

Friedman Test: b = subjects
k = character notes
m = trials

$$\chi^2_r = \frac{12}{b\ k\ m^2} \left[R_j - \frac{bm(mk+1)}{2} \right]^2$$

$\chi^2_r = 33.0168$

χ^2 at 0.05 level of significance = 9.488

APPENDIX D

METHOD FOR DETERMINING PANEL REPEATABILITY

TABLE XI

FRIEDMAN TEST TO MEASURE PROFILE REPEATABILITY IN V-8 JUICE

Character Note: Tomato			
Subject	Day 1	Day 2	Day 3
A	11.9 (1)*	12.3 (3)	12.1 (2)
B	5.6 (1)	10.7 (3)	8.3 (2)
C	12.7 (3)	9.4 (1)	9.9 (2)
D	12.4 (3)	10.9 (2)	9.8 (1)
E	10.1 (3)	8.9 (2)	8.7 (1)
F	10.7 (1)	11.2 (2)	11.5 (3)
	$R_1 = 12$	$R_2 = 13$	$R_3 = 11$

*Numbers in parentheses indicate ranking within individuals. The other numbers were derived from product evaluations completed by each subject for the particular character note. The Friedman test was applied to each character note within a product.

Frideman Test:

$$\chi = \frac{12}{bk(k+1)} \left[R_j^2 - 3b(k+1) \right]$$

b = subjects
k = trials

$\chi_r^2 = .333$

χ^2 at 0.05 level of significance = 5.991

VITA

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