Special Project

SENSORY ATTRIBUTE INDEX OF BANANA FIGS

By

Ms. Chutima Makim

A special project submitted to the Faculty of Biotechnology
Assumption University in part fulfillment of the Requirements
for the degree of Bachelor of Science in Biotechnology

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Abstract

This project was studied on the sensory attributes as an index of indicates the quality of the developed dried banana fig by using descriptive test. According to the survey from 40 consumers. The important factors which effect on the buying decision of the consumer were product characteristic, price, package and convenience, respectively. The most important product character of dried banana fig was wholesomeness. Using triangle test used Luangwang brand as a reference sample for training 8 panelists who were screened. The panelists generated 18 attributes, which are Brown Color, Burnt, Brightness, Burned Odor, Fermented Odor, Ripen Banana Odor, Sweeten Odor, Softness, Denseness, Sweetness, Saltiness, Sourness, Ripen Banana Flavor, Fermented Banana Flavor, Sweeten Flavor, Astringent aftertaste, Sweetness aftertaste, and Ripen Banana aftertaste. The descriptive test was indicated that the difference attributes of developed product (2.5% NaCl) from the reference conclude brown color, burnt, sourness, sweeten odor and denseness. The difference attributes of developed product (2.5% NaCl and 20% Glucose Syrup) from the reference conclude sourness, fermented flavor, sweeten odor and softness.

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Introduction

There are a lot of bananas in Thailand because it is easy to be cultivated and there is a lot of utilization. Some amount of bananas is excess customer's demand in a raw material so it is necessary to be preserved as vary products. The flavors, texture, convenience, ease of eating and nutritional values have made dessert bananas very popular. Banana is a useful source of vitamins A, C and B_6 and has about twice the concentration of K compared with other ripe fruit. Plantain as a staple provides considerable energy and protein, although the diet needs to be supplemented. Bananas are used in special diets where ease of digestibility, low fat, no cholesterol, minerals (high K), low sodium (Na), and vitamin content are required. The fruit does not cause digestive disturbance, it readily neutralizes free acid in the stomach and does not give rise to uric acid. These special diets are used for babies, the elderly and patients with stomach problems, gout and arthritis.

Only a very minor proportion of the total world banana production is processed. The procedures used include canning as slices, drying as slices or flakes, freezing of juice, extraction, frying and fermentation. Puree is canned or frozen and used in baby foods, baking and drinks. Banana essence is a clear colorless liquid used in desserts, juices and drinks. Dried, ripe fruit can be made into flour. The lack of acidity makes processing difficult, because of the need for pasteurization. A year-round supply of fresh fruit makes preservation less economic. A beer is brewed from plantains and consumed in Uganda and Tanzania.

A banana fig was studied since maturity of raw material, process development, and sensory evaluation. For this project, it focus on sensory evaluation to be useful for general people who are interested to use in their occupation or their research.

Aim

The project aim was to study about " Sensory attributes index of Dried Banana Fig" to assure the product quality from developed process whether it is accepted from consumer and to define which important attributes that affect to customer's need.

The test objectives were:

1. To research the marketing, and behavior in buying and consuming the product of consumers.

2. To select a reference of product that is accepted for training panelist. And then to define sensory properties of target product for product development.

Literature Review

BANANA

Banana is one of the most common and widely grown fruit crops in the Philippines. It is also one of the country's major dollar earners, and has consistently ranked next to coconut oil and prawns in terms of value earnings during the last five years.

In 1991, banana topped local production among the other major fruits such as pineapple and mango, thus eating up more than one-third of the production pie.

Banana has various uses. The ripe fruit is pureed, candied, and preserved in various forms when not eaten fresh. Its extract is used in the manufacture of catsup, vinegar, and wine. The unripe fruit is powdered and chipped.

In rural areas, the young leaves are pounded to suppress bleeding and treat wounds. The leaves are also widely used as packing materials for fruits and vegetables in market centers. Banana fiber is manufactured into rope, sack, and mat. Sheets of paper and paper boards are also made from banana peel. Banana blossom is exported dried. Filipino housewives use it in special dishes.

HARVESTING

Regardless of variety, the maturity of banana can be distinguished when the last leaf turns yellow. The angle formation of the fingers also determines ripeness. The rounder the angle of the fingers, the more mature the are.

Saba is harvest 15 to 16 months after planting; Lacatan, 4 to 15 months; Latundan, 12 months; Bungulan, 12 months; Cavendish, six to eight months.

BANANA PRODUCT

Banana Figs

- Select firm, ripe Cavendish bananas.
- Peel.
- Blanch for 30 seconds in boiling syrup made up of one part water and ¾ part sugar. Brown sugar may be used.
- Cook for one minute.
- Remove from fire and let bananas soak in the syrup overnight.
- Drain bananas.
- Add ¼ part sugar to syrup and boil.
- Add bananas and cook for one minute.
- Everyday for three more days, concentrate syrup by boiling for five to seven minutes.
- Soak bananas. On the final concentration, the syrup must attain a thick consistency.
- Soak bananas in the thick syrup for a week to plump and be thoroughly impregnated with syrup.
- Drain bananas and dry. The figs when dried can be handled without sticking to the finger.

Dried bananas, or so-called "banana figs" are peeled firm-ripe bananas split lengthwise, sulphured, and ovendried to a moisture content of 18 to 20%. Wrapped individually in plastic and then packed by the dozen in polyethylene bags, and encased in cartons, they can be stored for a year at room temperature—75.2° to 86°F (24°-30°C) and they are commonly exported. (http://www.da.gov.ph/tips/banana.html)

Table1: Dietary value, per 100 gram edible portion:

Banana (Plantains a bit higher in calories, but similar)

Water (%)	74 (low for a fresh fruit)
Calories	88
Protein (%)	1.5
Fat (%)	0.28
Carbohydrates (%)	22
Crude Fiber (%)	0.6
% of US RDA*	
Vitamin A	9
Thiamin, B1	21
Riboflavin, B2	3.8
Niacin	4.4
Vitamic C	47
Calcium	1.1
Phosphorus	3.5
Iron	4.5
Sodium	---
Potassium	9

* Percent of recommended daily allowance set by FDA, assuming a 154 lb male adult, 2700 calories per day. (http://www.uga.edu/fruit/banana.htm#harvest)

Sensory Attributes

The attributes of a food item in the following order:

- Appearance
- Odor/aroma/fragrance
- Consistency and texture
- Flavor (aromatics, chemical feelings, taste)

Appearance

As every shopper knows, the appearance is often the only attribute on which we can base a decision to purchase or consume. Hence, we become adept at making wide and risky inferences from small clues, and test subjects will do the same in the booth. In follows that the sensory analyst must pay meticulous attention to every aspect of the appearance of test samples (Amerineet al., 1965, p.399; McDougall, 1983) and must often attempt to obliterate or mask much of it with colored lights, opaque containers, etc.

Color	A phenomenon that involves both physical and psychological components: the perception by the visual system of light of wavelengths 400 to 500 nm (blue), 500 to 600 nm (green and yellow), and 600 to 800 nm (red), commonly expressed in terms of the hue, value, and chroma of the Munsell color system. The evenness of color as opposed to uneven or blotchy appearance is important. Deterioration of food is often accompanied by a color change. Good descriptions of procedures for sensory evaluation of appearance and color are given by Clydesdale (1984), McDougall (1988) and Lawless and Heymann (1998).
Surface textures	The dullness or shininess of a surface, the roughness vs. evenness; does the surface appear wet or dry, soft or hard, crisp or tough.

Odor/Aroma/Fragrance

The odor of a product is detected when its volatiles enter the nasal passage and are perceived by the olfactory system. We talk of odor when the volatiles are sniffed through the nose (voluntarily or otherwise). Aroma is the odor of a food product, and fragrance is the odor of a perfume or cosmetic. Aromatics, as mentioned earlier, are the volatiles perceived by the olfactory system from a substance in the mouth. (The term smell is not used in this book because it has a negative connotation [= malodor] to some people while to others it is the same as odor.)(Laing, 1983).

Consistency and Texture

The third set of attributes to be considered are those perceived by sensors in the mouth, other than taste and chemical feelings. By convention we refer to:

- Viscosity (for homogeneous Newtonian liquids)
- Consistency (for non-Newtonian or heterogeneous liquids and semisolids)
- Texture (for solids or semisolids)

"Texture" is much more complex, as shown by the existence of the *Journal of Texture Studies*. Texture can be defined as the sensory manifestation of the structure or inner makeup of products in terms of their:

- Reaction to stress, measured as mechanical properties (such as hardness/firmness, adhesiveness, cohesiveness, gumminess, springiness/resilience, viscosity) by the kinesthetic sense in the muscles of the hand, fingers, tongue, jaw, or lips.
- Tactile feel properties, measured as geometrical particles (grainy, gritty, crystalline, flaky) or moisture properties (wetness, oiliness, moistness, dryness) by the tactile nerves in the surface of the skin of the hand, lips, or tongue.

Recommended reviews of texture perception and measurement are those by De Man et al. (1976), Bourne (1982), and Brennan (1988).

Flavor

Flavor, as an attribute of foods, beverages, and seasonings, has been defined (Amerine et al., 1965, p.549) as the sum of perceptions resulting from stimulation of the sense ends that are grouped together at the entrance of the alimentary and respiratory tracts, but for purposes of practical sensory analysis, the authors prefer tofollow Caul (1957) and restrict the term to *the impressions perceived via the chemical senses from a product in the mouth.* Defined in this manner, flavor includes:

- The aromatics, i.e., olfactory perceptions caused by volatile substances released from a product in the mouth via the posterior nares
- The tastes, i.e., gustatory perceptions (salty, sweet, sour, bitter) caused by soluble substances in the mouth
- The chemical feeling factors, which stimulate nerve ends in the soft membrances of the buccal and nasal cavities (astringency, spice heat, cooling, bite, metallic flavor, umami taste)

The large numbers of individual flavor words are listed in Civille and Lyon (loc. cit.).

Controls for Test Room, Product, and Panel

Many variables must be controlled if the results of a sensory test are to measure the true product differences under investigation. It is convenient to group these variables under three major headings:

Test controls: The test room environment, the use of booths or a round table, the lighting, the room air, the preparation area, the entry and exit areas.

Product controls: The equipment used, the way samples are screened, prepared, numbered, coded, and served.

Panel controls: The procedure to be used by a panelist evaluating the sample in question.

Test Controls

The physical setting must be designed so as to minimize the subjects' biases, maximize their sensitivity, and eliminate variables which do not come from the products themselves. Panel tests are costly because of the high cost of panelists' time. A high level of reduction of disturbing factors is easily justified. Dropoffs in panel attendance and panel motivation are universal problems, and management must clearly show the value it places on panel tests by the care, and free of crowding and confusion, as well as comfortable, quiet, temperature controlled, and above all, free from odors and noise.

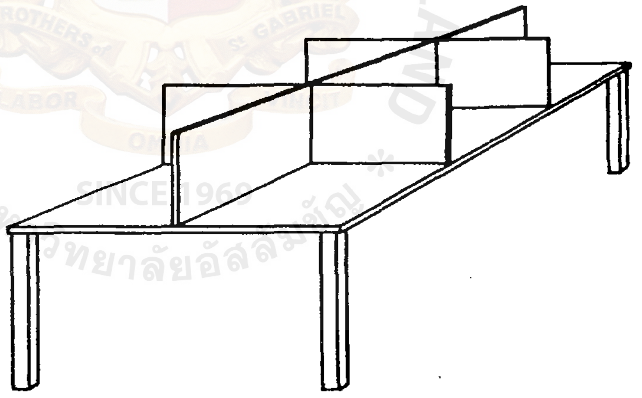

Figure1: Simple booths consisting of a set of dividers placed on a table.

Figure2: (a) Circular table with "lazy Susan" used for consensus-type descriptive analysis. (Courtesy of Ross Products Division, Columbus, OH.) (b) Round table discussion used for descriptive analysis ballot development. (Courtesy of NutraSweet/Kelco Inc., Mt. Pleasant, IL.)

Test Room Design

1. The Booth

It is customary for one sample preparation area to serve six to eight booths. The booths may be arranged all side-by-side, in an L-shape, or with two sets of three to four booths facting each other across the serving area. The L-shape represents the most efficient use of the "work triangle" concept in the kitchen design, resulting in a minimum of time and distance covered by technicians in serving samples. One unit of six to eight booths will accommodate a moderate test volume of 300 to 400 sittings per year of panels up to 18 to 24 members. For higher volumes of testing and/or larger panels, multiple units served from one or several preparation areas are recommended. Consideration also should be given to placement of the technicians' monitor(s) and central processing unit(s) for any automated data handling system.

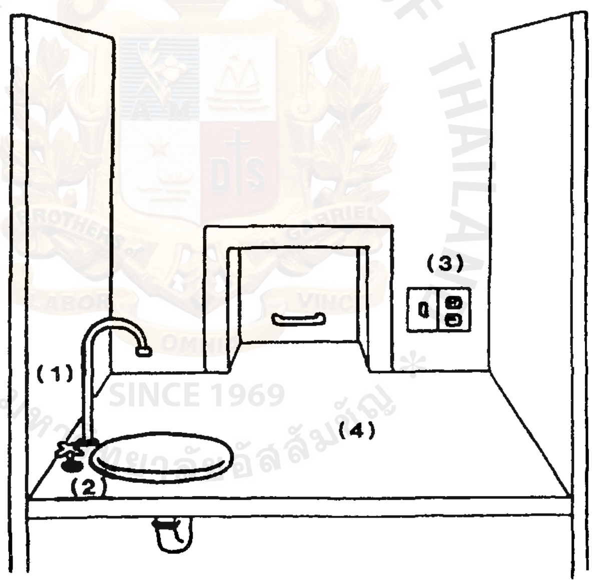

Figure3: Sensory evaluation booth with hatch (in background) for receipt and return of sample tray. (1) Tap water; (2) small sink; (3) electrical outlet and signal switch to panel attendant; (4) table covered with odorless Formica or other easy-to-clean surface.

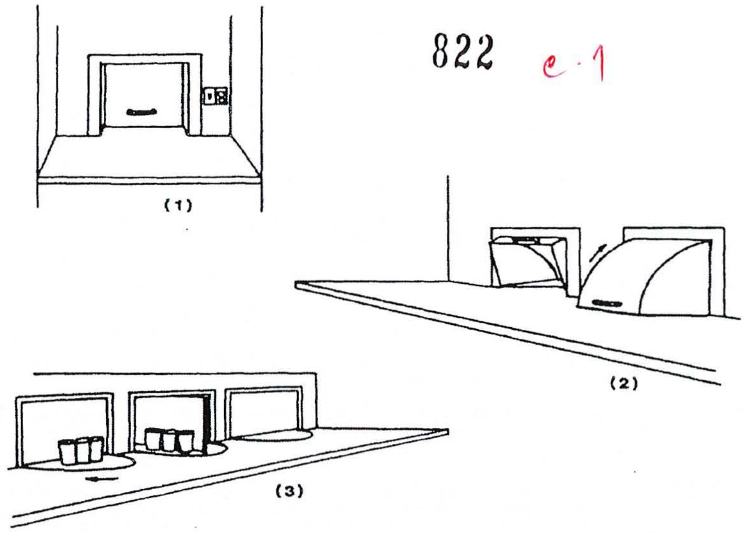

Figure 4: Three types of hatch for passing samples to and from the panelists. (1) Sliding door; (2) breadbox; (3) carousel.

2. Descriptive Evaluation and Training Area

As a minimum, this function may be filled by a table in the panel leader's office where standards may be served as a means of educating panel members. At the other extreme, if descriptive analysis is a common requirement or if needs for training and testing are large, the following equipment is recommended:

A conference-style room with several tables which can be arranged as required by the size and objective of the group

Audiovisual equipment which may include an "electronic white board" capable of making hard copies of results, etc. entered on it

Separate preparation facilities for reference samples used to illustrate the descriptors; depending on type, these may include a storage space (frozen, refrigerated, or room temperature, perhaps sealed to prevent odors from escaping) and a holding area for preparing the references (perhaps hooded)

3. Preparation Area

The preparation area is a laboratory which must permit preparation of all of the possible and foreseeable combinations of test samples at the maximum rate at which they are required. Each booth area and descriptive analysis area should have a separate preparation laboratory so as to maximize the technician's ability to prepare, present, and clean up each study.

4. Office Facilities

An office is usually situated within view of the panel booths as someone must be present while testing is in progress. It may be convenient to locate records, storage space, and computer terminals and other hardware (printers, digitizers, plotters, etc.) in the same area so that the panel leader's time may be effectively utilized. Equipment such as paging phones and printers should be at a sufficient distance to avoid distracting the subjects.

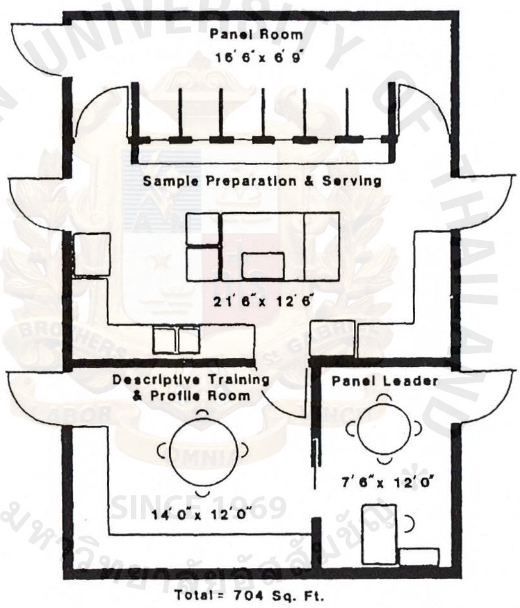

Figure 5: Layout for medium-size sensory evaluation area suitable for 300 to 400 tests per year. (Drawn by D. Grabowski.)

Product Controls

Sample Preparation

1. Supplies and Equipment

In addition to the necessary major appliances, the controlled preparation of products requires adequate supplies and equipment such as:

- Scales, for weighting products and ingredients

- Glassware, for measurement and storage of product
- Timers, for monitoring of preparation procedures
- Stainless steel equipment, for mixing and storing products, etc.

2. Materials

Equipment used for preparation and presentation of samples must be carefully selected to reduce the introduction of biases and new variables. Most plastic cutely, storage containers, and wraps or bags are unsuitable for preparation of foods, beverages, or personal care products. The transfer of volatiles to and from the plastic can change the aroma and/or flavor characteristics of a product.

Containers used for storage, preparation, or serving should therefore be glass, glazed china, or stainless steel because of the reduced transfer of volatiles with these materials. Plastic, which has been pretested for low odor transfer, should be used only when the test product(s) will be held for less than 10 min in the container during and prior to the test.

3. Preparation Procedures

The controlled preparation of products requires careful regulation and monitoring of procedures used, with attention given to:

- Amount of product tot be used, measured by weight or volume using precise equipment (volumetric cylinders, gram scales, etc.)
- Amount of each added ingredient (as above)
- The process of preparation, regulation of time (stopwatch), temperature (thermometers, thermocouples),rate of agitation (rpm), size, and type of preparation equipment
- Holding time defined as the minimum and maximum time after preparation that a product can be used for a sensory test

Sample Presentation

1. Container, Sample Size, and Other Particulars

The equipment and procedures used for product presentation during the test must be carefully selected to reduce introduction of biases and new variables. Attention should be given to control of the following.

Serving containers- glass or glazed china, not plastic unless tested.

Serving size- Technicians should be carefully trained to deliver the correct amount of product with the least amount of handling. Special equipment may be advantageous for measuring precise amounts of a product for sensory testing.

Serving temperature- After the sample is distributed into each serving container, and just before serving, the product should be checked to determine if it is at the appropriate temperature. Most sensory laboratories develop standard preparation procedures which determine the needed temperature in the preparation container, which is necessary to ensure the required temperature after delivery to the tasting/smelling container. The use of standard procedures greatly reduces the need for monitoring of each individual portion.

2. Order, Coding, and Number of Samples

As part of any test, the order, coding, and number of samples presented to each subject must be monitored.

The *order of presentation* should be *balanced* so that each sample appears in a given position an equal number of times

The presentation also should be *random*, which may be achieved by drawing sample cards from a bag or by using a compilation of random numbers.

The codes assigned to each product can be biasing: for example, subjects may subconsciously choose samples marked. A over those marked with other letters. Therefore, single and double letters and digits are best avoided.

Product Sampling

The sensory analyst should determine how much of a product is required and should know the history of the products to be tested. Information about prior handling of experimental and control samples is important in the design of the test and interpretation of the results. A log book should be kept in the sensory laboratory to record pertinent sample data:

- The source of the product: when and where it was made. Sample identification is necessary for laboratory samples (lab

notebook number) as well as production samples (data ad machine codes).
- The testing needs: how much product will be required for all of the tests to be run, and possible rerun, for this evaluation. All of the product representing a sample should come from one source (same place, same line, same data, etc.). If the product is not uniform, attempts should be made to blend and repackage the different batches.
- The storage: where the sample has been and under what conditions. If two products are to be compared for a processing or ingredient variable, it is not possible to measure the treatment effect if there are differences in age, storage temperature and humidity, shipping storage and humidity, packaging differences, etc. which can cloud the measurement.

Panelist Controls

The way in which a panelist interacts with the environment, the product, and the test procedure are all potential sources of variation in the test design. Control or regulation of these interactions is essential to minimizing the extraneous variables, which may potentially bias the results.

Panel Training or Orientation

It goes without saying that panelists need careful instruction with respect to the handling of samples, the use of the scoresheeet, and the information sought in the test. As a minimum, panelists must be prepared to participate in a laboratory sensory test with no instruction from the sensory analysts once the test has started. They should be thoroughly familiar with:

- The test procedures
- The score sheet design
- The type of judgment/evaluation required (difference, description, preference, acceptance)

Kelly and Heymann (1989) found no significant difference between ingestion and expectoration in tests, e.g., with added salt in kidney beans; ingestion did produce narrower confidence limits.

Product/Time of Day

With panelists who are not highly trained it is wise to schedule the evaluation of certain product types at the time of day when that product is normally used or consumed. The tasting of highly flavored or alcoholic products in the early morning is not recommended. Product testing just after meals or coffee breaks also may introduce bias and should be avoided. Some preconditioning of the panelists' skin or mouth may be necessary in order to improve the consistency of verdicts.

Panelists/Environment

The test environment, as seen by the panelist, must be controlled if biases are to be avoided. Note, however, that certain controls, such as colored lights, high humidity, or enclosed testing area, may cause anxiety or distraction, unless panelists are given ample opportunity to become used to such "different" surroundings.

Measuring Responses

Panelists assign numbers or labels to sensory impressions, they may do this in at least four ways:

- Nominal data: (Latin: *nomen* = name): the items examined are placed in two or more groups which differ in name but do not obey any particular order or any quantitative relationship; example: the numbers carried by football players.
- Ordinal data: (Latin: *ordinalis* = order): the panelist places the items examined into two or more groups which belong to an ordered series; example: slight, moderate, strong.
- Interval data: (Latin: *inter vallum* = space between ramparts): panelists place the items into numbered grouped separated by a constant interval; example: three, four, five, six.
- Ratio data: Panelists use numbers which indicate how many times the stimulus in question is stronger (or saltier, or more irritating) than a reference stimulus presented earlier.

Nominal data contain the least information. Ordinal data carry more information and can be analyzed by most nonparametric statistical tests. Interval and ratio data are even better because they can be analyzed by all nonparametric and often by parametric methods. Ratio data are preferred by some because they are free from end-of-scale distortions; however, in practice, interval data, which are easier to collect, appear to give equal results.

Triangle Test

The section on the Triangle test is rather complex and includes many details which (1) all sensory analysts should know; (2) are common to many methods; and (3) are therefore omitted in subsequent methodes.

Scope and Application

Use this method when the test objective is to determine whether a sensory difference exists between two products. This method is particularly useful in situation where treatment effects may have produced product changes, which cannot be characterized simply by one or two attributes. Although it is statistically more efficient than the paired comparison and duo-trio methods, the Triangle test has limited use with products that involve sensory fatique, carryover or adaptation, and with subjects who find testing three samples too confusing. This method is effective in certain situations:

1. To determine whether product differences result from a change in ingredients, processing, packaging, or storage
2. To determine whether an overall difference exists, where no specific attribute(s) can be identified as having been affected
3. To select and monitor panelists for ability to discriminate given differences

Principle of The Test

Present to each subject three coded samples. Instruct subjects that two samples are identical and one is different (or odd). Ask the subjects to taste (feel, examine) each product from left to right and select the odd sample. Count the number of correct replies and refer to T8* for interpretation.

Test Subjects

Generally, 20 to 40 subjects are used for Triangle tests, although as few as 12 may be employed when differences are large and easy to spot. Similarity testing, on the other hand, requires 50 to 100 subjects. As a minimum, subjects should be familiar with the Triangle test (the format, the task, the procedure for evaluation), and with the product being tested, especially because flavor memory plays a part in triangle testing.

Test Procedure

The test controls should include a partitioned test area in which each subject can work independently. Control of lighting may be necessary to reduce any color variables. Prepare and present samples under optimum conditions for the product type investigated, e.g., samples should be appetizing and well presented.

Offer samples simultaneously, if possible; however, samples which are bulky, leave an aftertaste, or show slight differences in appearance may be offered sequentially without invalidating the test,

Prepare equal numbers of the six possible combinations (ABB, BAA, AAB, BBA, ABA, and BAB) and present these at random to the subjects. Ask subjects to examine (taste, feel, smell, etc.) the samples in the order from left to right, with the option of going back to repeat the evaluation of each, while the test is in progress.

The score sheet could provide for more than one set of samples. However, this can only be done if sensory fatigue is minimal. Do not ask questions about preference, acceptance, degree of difference, or type of difference after the initial selection of the odd sample. This is because the subject's choice of the odd sample may bias his/her responses to these additional questions. Responses to such questions may be obtained through additional tests.

Analysis and Interpretation of Results

Count the number of correct responses (correctly identified odd samples) and the number of total responses. Determine if the number correct for the number tested is equal to or larger than the number indicated in Table T8.

Do not count "no difference" replies as valid responses. Instruct subjects to guess if the odd sample is not detectable.

Simple Ranking Test: Friedman Analysis-Randomized (Complete) Block Design

Scope and Application

Use this method when the test objective is to compare several samples according to a single attribute, e.g., sweetness, freshness, and preference. Ranking is the simplest way to perform such comparisons, but the data are merely ordinal, and no measure of the degree of difference is obtained from each respondent. One rank unit will separate consecutive samples, which differ widely, as well as those, which differ slightly. A good, detailed discussion of the virtues and limitations of rank data is given by Pangborn (1984). Ranking is less time-consuming than other methods and is particularly useful when samples are to be presorted or screened for later analysis.

Principle of The Test

Present the set of samples to each subject in balanced, random order. Ask subjects to rank them according to the attribute of interest. Calculate the rank sums and evaluate them statistically with the aid of Friedman's test.

Test Subjects

Use no fewer than 8 subjects; discrimination is much improved if 16 or more can be used. Subjects may require special instruction or training to enable them to recognize the attribute of interest reproducibly. Depending on the test objective, subjects may be selected on the basis of proven ability to detect small differences in the attribute.

Test Procedure

Test and product should be controlled. Offer samples simultaneously if possible, or else sequentially. The subject receives the set of *t* samples in balanced random order, and the task is to rearrange them in rank order. The set may be presented once or several times with different coding. Accuracy is much improved if the set can be presented two or more times. In preference tests, instruct subjects to assign rank 1 to the preferred sample, rank 2 to the next preferred, etc. For intensity tests, instruct subjects to rank 1 to the lowest intensity, rank 2 to the next lowest, etc.

Recommend that subjects arrange the samples in a provisional order based upon a first trial of each and then verify or change the order based on further testing. Instruct subjects to make a "best guess" about adjacent samples, even if they appear to be the same; however, if a subject declines to guess, he or she should indicate under "comments" the samples considered identical. Assign the average rank to each of the identical samples for statistical analysis. For instance, in a four-sample test, if a panelist cannot differentiate the two middle samples, assign the average rank of 2.5 to each, i.e., (2+3)/2.

If a rank order for more than one attribute of the same set of samples is needed, carry out the procedure separately for each attribute, using new samples coded differently so that one evaluation does not affect the next. A score sheet is shown in Figure 7.4. Space for several sets of samples may be provided, but note that a new set of codes is required for each set, and it is often simpler to supply one score sheet for each set and subject.

Analysis and Interpretation of Results

Analysis by Friedman's test (Friedman, 1937; Hollander and Wolfe, 1973) is preferred to the use of Kramer's tables (Kramer et al., 1974), as the latter provides inaccurate evaluation of samples of intermediate rank.

Selection and Training for Difference Tests

Selection

Assume that the early recruitment procedure has provide a group of candidates free of obvious drawbacks, such as heavy travel or work schedules or health problems, which would make participation impossible or sporadic. The sensory analyst must now devise a set of screening tests which teach the candidates the test process while weeding out unsuitable nondiscriminators as early as possible. Such screening tests should *use the products to be studied* and *the sensory methods to be used in the study*. It follows that they should be patterned on those described below, rather than using them directly. The screening tests aim to determine differences among candidates in the ability to: (1) discriminate (and describe, if attribute difference tests are to be used) character differences among products, and (2) discriminate (and describe with a scale for attribute difference tests) differences in the intensity or strength of the characteristic.

Suggested rules for evaluating the results are given at the end of each section. Bear in mind that while candidates with high success rates may on the whole be satisfactory, the best panel will result if selection can be based on potential rather than on current performance.

Detection/Discrimination Tests

This type of selection test is used to determine a candidate's ability to detect differences among similar products with ingredient or processing variables. Present candidates with a series of three or more Triangle test (Rainey, 1976; Zook and Wessman, 1977) with differences ranging from easy to moderately difficult. Arrange preliminary tests with experienced tasters to determine the optimal order of the test series and to control that stimulus levels are appropriate and detectable, but not overpowering. Use standard Triangle or Duo-trio score sheets when suitable. If desired, use sequential Triangle tests to decide acceptance or rejection of candidates. However, as already mentioned, do not rely too much on taste acuity.

Selection and Training of Panelists for Descriptive Testing

Selection for Descriptive Testing

When selecting panelists for descriptive analysis, the panel leader or panel trainer needs to determine each candidate's capabilities in three major areas:

1. For each of the sensory properties under investigation (such as fragrance, flavor, oral texture, or skinfeel) the ability to detect differences in characteristics present and in their intensities
2. The ability to describe those characteristics using (a) verbal descriptors for the characteristics and (b) scaling methods for the differences in intensity
3. The capacity for abstract reasoning, as descriptive analysis depends heavily upon the use of references when characteristics must be quickly recalled and applied to other products

   In addition to screening panelists for these descriptive capabilities, panel leaders must prescreen candidates for the following personal criteria:

1. Interest in full participation in the rigors of the training, practice, and ongoing work phases of a descriptive panel
2. Availability to participate in 80% or more of all phases of the panel's work; conflict with work load, travel, or even the candidates's supervisor perhaps eventually causing the panelist to drop off the panel during or after training, thus losing one panelist from an already small number of 10 to 15
3. General good health and no illness related to the sensory properties being measured.

The ability to detect and describe differences, the ability to apply abstract concepts, and the degree of positive attitude and predilection for the tasks of descriptive analysis can all be determined through a series of tests which include

Personal Interview

Especially for descriptive panels, a personal interview is necessary in order to determine whether candidates are well suited to the group dynamics and analytical approach. Generally, candidates who have passed the prescreening questionnaire and all of the acuity tests are interviewed individually by the panel trainer or panel leader. The objective of the interview is to confirm the candidante's interest in the training and work phases of the panel including his/her availability with respect to work load, supervisor, and travel, and also communication skill and general personality. Candidates who express little interest in the sensory programs as a whole and in the descriptive panel in particular should be excused. Individuals with very hostile or very timid personalities may also be excluded, as they may detract from the needed positive input of each panelist.

Consumer surveys

Consumer surveys are inherent to market research and have been the basis of much of Joan's product development research. Her experience has included designing concept development, product interest or use questionnaires, and habits and practices research in the areas of food, beverages, household cleaning, personal cleansing, and health and beauty products. She has managed these studies in the field as well as directing their execution through national and international suppliers. Her project design work has encompassed mail and phone contact, mall intercept, and central location studies. She has designed and executed in-store sampling, couponing, and promotions. Data analysis and reporting to project teams and management have always been integral to her project management.

Descriptive Analysis Techniques

All descriptive analysis methods involve the detection (discrimination) and the description of both the qualitative and quantitative sensory aspects of a product by trained panels of 5 to 100 judges (subjects). Smaller panels of five to ten subjects are used for the typical product on the grocery shelf while the larger panels are used for products of mass production such as beers and soft drinks, where small differences can be very important.

Panelists must be able to detect and describe the perceived sensory attributes of a sample. These qualitative aspects of a product combine to define the product, and include all of the appearance, aroma, flavor, texture, or sound properties of a product which differentiate it from others. In addition, panelists must learn to differentiate and rate the quantitative or intensity aspects of a sample and to define to what degree each characteristic or qualitative note is present in that sample. Two products may contain the same qualitative descriptors, but they may differ markedly in the intensity of each, thus resulting in quite different and easily distinctive sensory profiles or pictures of each product. The two samples below have the same qualitative descriptors, but they differ substantially in the amount of each characteristic (quantitatively). The numbers used represent intensity ratings on a 15-cm line scale on which a zero means no detectable amount of the attribute, and 15 cm means a very large amount (Civille, 1979).

Components of Descriptive analysis

Characteristics: The Qualitative Aspect

Those perceived sensory parameters which define the product are deferred to by various terms such as attributes, characteristics, character notes, descriptive terms, descriptors, or terminology (Johnsenet al., 1988).

These qualitative factors include terms which define the sensory profile or picture or thumbprint of the sample. An impotant aspect is that panelists, unless well trained, may have very different concepts of what a term means. The question of concept formation is reviewed in detail by Lawless and Heymann (1998). The selection of sensory attributes and the corresponding definition of these attributes should be related to the real chemical and physical properties of a product which can be perceived (Civille and Lawless, 1986). Adherence to an understanding of the actual rheology or chemistry of a product make the descriptive data easier to interpret and more useful for decision making. Statistical methods such as ANOVA and multivariate analysis can be used to select the more descriptive terms (Jeltema and Southwick, 1986; ISO, 1994).

The components of a number of different descriptive profiles are given below (a number of examples of each are shown in parentheses). The repeat appearance of certain properties and examples is intentional.

1. Appearance characteristics
    a. Color (hue, chroma, uniformity, depth)
    b. Surface texture (shine, smoothness/roughness)
    c. Size and shape (dimensions and geometry)
    d. Interactions among pieces or particles (stickiness, agglomeration, loose particles)
2. Aroma characteristics
    a. Olfactory sensations (vanilla, fruity, flaral, skunky)
    b. Nasal feeling factors (cool, pungent)
3. Flavor characteristics
    a. Olfactory sensations (vanilla, fruity, floral, chocolate, skunky, rancid)
    b. Taste sensations (salty, sweet, sour, bitter)

    c. Oral feeling factors (heat, cool, burn, astringent, metallic)
4. Oral texture characteristics (Szczesniak, 1963; Szczesniak et al. 1963; Brandt et al., 1963)
    a. Mechanical parameters, reaction of the product to stress (hardness, viscosity, deformation/fracturability)
    b. Geometrical parameters, i.e., size, shape and orientation of particles in the product (gritty, grainy, flaky, stringy)
    c. Fat/moisture parameters, i.e., presence, release and adsorption of fat, oil, or water (oily, greasy, juicy, moist, wet)
5. Skinfeel characteristics (Schwartz, 1975; ASTM 1997a; Civille And Dus, 1991)
    a. Mechanical parameters, reaction of the product to stress (thickness, ease to spread, slipperiness, denseness)
    b. Geometrical parameters, i.e., size, shape, and orientation of particles in product or on skin after use (gritty, foamy, flaky)
    c. Fat/moisture parameters, i.e., presence, release, and absorption of fat, oil, or water (greasy, oily, dry, wet)
    d. Appearance parameters, visual changes during product use (gloss, whitening, peaking)

6. Texture/handfeel of woven and nonwoven fabrics (Civille and Dus, 1990)
    a. Mechanical properties, reactions to stress (stiffness, force to compress or stretch, resilience)
    b. Geometrical properties, i.e., size, shape, and orientation of particles (gritty, bumpy, grainy, ribbed, fuzzy)
    c. Moisture properties, presence and absorption of moisture (dry, wet, oily, absorbent)

Again, the keys to the validity and reliability of descriptive analysis testing are:

- Terms based on a thorough understanding of the technical and physiological principles of flavor or texture or appearance
- Thorough training of all panelists to fully understand the terms in the same way and to apply them in the same way
- Use of references for terminology to ensure consistent application of the carrier and descriptive terms to a perception

Intensity: The quantitative Aspect

The intensity or quantitative aspect of a descriptive analysis express the degree to which each of the characteristics (terms, qualitative components) is present. This is expressed by the assignment of some *value* along a measurement scale.

As with the validity and reliability of terminology, the validity and reliability of intensity measurements are highly dependent upon:

- The selection of a scaling technique which is broad enough to encompass the full range of parameter intensities and which has enough discrete points to pick up all the small differences in intensity between samples.
- The thorough training of the panelists to use the scale in a similar way across all samples and across time.
- The use of reference scales for intensity of different properties to ensure consistent use of scales for different intensities of sensory properties across panelists and repeated evaluations.

Training for Descriptive Testing

The important aspect of any training sequence is to provide a structured framework for learning based on demonstrated facts and to allow the students, in this case panelists, to grow in both skills and confidence. Most descriptive panel training programs require between 40 and 120 h of training. The amount of time needed depends on the complexity of the product, on the number of attributes to be covered, and on the requirements for validity and reliability (a more experienced panel will provide greater detail with greater reproducibility).

1. Terminology Development

The panel leader or panel trainer in conjuction with the project team must identify key product variables to be demonstrated to the panel during the initial stages of training. The project team should prepare a prototype or collect from commercially available samples an array of products as a frame of reference, which represents as many as possible of the attribute differences likely to be encountered in the product category. The panel is first introduced to the chemical (olfaction, taste, chemical feeling factors) and physical principles (rheological, geometrical, etc.) which govern or influence the perception of each product attribute. With these concepts and terms as a foundation, the panel then develops procedures for evaluation and terminology with definitions and references for the product class.

Typically, the first stage of training may require 15 to 20 h as panelists begin to develop an understanding of the broad array of descriptors which fall into the category being studied (appearance, flavor, oral texture,etc.) This first phase is designed to provide them with a firm background in the underlying modality and for them to begin to perceive the different characteristics as they are manifest in different product types.

2. Introduction to Descriptive Scaling

The scaling method of choice may be introduced during the first 10 to 20 h of training. By using a set of products or references which represent 3 to 5 different levels of each attribute, the panel leader reinforces both the sensory characteristic and the scaling method, by demonstrating different levels or intensities across several attributes.

The continued use of intensity reference scales during practice is meant to provide continued reinforcement of both attributes and intensities, so that the panel begins to see the descriptive process as a use of terms and numbers (characteristics and intensities) to define or document any product in the category learned.

3. Initial Practice

The development of a precise lexicon for a given product category is often a three-step process. In the first step a full array of products, prototypes, or examples of product characteristics is presenteed to the panel as a frame of reference. From this frame of reference the panel generates an original long list of descriptors to which all panelists are invited to contribute. In the second stage, the original list, containing many overlapping terms, is rearranged and reduced into a working list in which the descriptors are comprehensive (they describe the product category completely) and yet discrete (overlapping is minimized). The third and last stage consists of choosing products, prototypes, and external references which can serve to represent good examples of the selected terms.

Once the panel has a grasp on the terminology and a general understanding of the use of each scale, the panel trainer or leader presents a series of samples to be evaluated one at a time, generally two or more of which represent a *very* wide spread in qualitative (attributes) and quantitative (intensiry) differences. At this early stage of development, which lasts 15 to 40 h, the panel gains basic skills and confidence. The disparate samples allow the panel to see that terms and scales are effective as descriptors and discriminators, and help the members to gain confidence both as individuals and as a group.

4. Small Product Differences

With the help of the project/product team, the panel leader collects samples which represent smaller differences within the product class, including variations in producting variables and/or bench modifications of the product. The panel is encouraged to refine the procedures for evaluation and terminology with definitions and references to meet the needs of detecting and describing product differences. Care must be taken to reduce variations between supposedly identical samples; panelists in training tend to see variability in results as a reflection of their own lack of skill. Sample consistency contributes to panel confidence. This stage represents 10 to 15 h of panel time.

5. Final Practice

The panel should continue to test and describe several products during the final practice stage of training (15 to 40 h). The earlier samples should be fairly different, and the final products tested should approach the real world testing situations for which the panel will be used.

During all five stages of the training program, panelists should meet after each session and discuss results, resolve problems or controversies, and ask for additional qualitative or quantitative references for review. This type of interaction is essential for developing the common terminology, procedures for evaluation, and scaling techniques which characterize a finely tuned sensory instrument.

The Subjects/Consumers in Affective Tests

Sampling and Demographics

Whenever a sensory test is conducted, a group of subjects is selected as a *sample* of some larger population, about which the sensory analyst hopes to draw some conclusion. In the case of discrimination tests (difference tests and descriptive tests), the sensory analyst samples individuals with average or above-average abilities to detect differences. It is assumed that if these individuals cannot "see" a difference, the larger human population will be unable to see it. In the case of affective tests, however, it is not sufficient to merely select or sample from the vast human or population. Consumer goods and services try to meet the needs of target populations, select markets, or carefully chosen segments of the population. Such criteria require that the sensory analyst first determine *the population for whom the product (or service) is intended;* e.g., for a sweetened breakfast cereal, the target population may be children between the ages of 4 and 12; for a sushi and yogurt blend, the select market may be Southern California; and for a high-priced jewelry item, clothing, or an automobile, the segment of the general population may be young, 25 to 35, upwardly mobile professionals, both married and unmarried.

Consumer researchers need to balance the need to identify and use a sample of consumers who represent the target population against the cost of having a very precise demographic model. With widely used products such as regular cereals, soft drinks, beer, cookies, and facial tissues reseach guidance consumer tests may require selection only of users or potential users of the product brand or category. The cost of stricter demographic criteria described as follows may be justified for the later stages of consumer research guidance or for marketing research tests. Among the demographics to be considered in selecting sample subjects are: **Age- Sex- Nationality, region, race, religion, education, employment-** Meilgaard (1992) and Resurreccion (1998).

Choice of Test Location

The test location or test site has numerous effects on the results, not only because of the geographic location, but also because the place in which the test is conducted defines several other aspects of the way the product is sampled and perceived. It is possible to get different results from different test sites with a given set of samples and consumers. These differences occur as a result of differences in:

1. The length of time the products are used/tested
2. Controlled preparation vs. normal-use preparation of the product
3. The perception of the product alone in a central location vs. in conjunction with other foods or personal care items in the home
4. The influence of family members on each other in the home
5. The length and complexity of the questionnaire

For a more detailed discussion, see Resurreccion (1998).

Central Location Tests

Central location teats are usually conducted in an area where many potential purchasers congregate or can be assembled. The organizer set up a booth or rents a room at a fair, shopping mall, church, or test agency. A product used by schoolchildren may be tested in the school playground; a product for analytical chemists, at a professional convention. Respondents are intercepted and screened in the open, and those selected for testing are led to a closed-off area. Subjects can also be prescreened by phone and invited to a test site. Typically, 50 to 300 responses are collected per location. Products are prepared out of sight and served on uniform plates (cups, glasses) labeled with three-digit codes. The potential for distraction may be high, so instructions and questions should be clear and concise; examples of scoresheets are given in Appendix 12.1. In a variant of the procedure, products are dispensed openly from original packaging, and respondents are shown storyboards with examples of advertising and descriptions of how products will be positioned in the market.

The advantages of central location tests are:

1. Respondents evaluate the product under conditions controlled by the organizer; any misunderstandings can be cleared up and a truer response obtained.
2. The products are tested by the end users themselves which assures the validity of the results.
3. Conditions are favorable for a high percentage return of responses from a large sample population.
4. Several products may be tested by one consumer during a test session, thus allowing for a considerable amount of information for the cost per consumer.

The main disadvantages of central location tests are:

1. The product is being tested under conditions which are quite artificial compared to normal use at home or at parties, restaurants, etc. in terms of preparation, amount consumed, and length and time of use.
2. The number of questions that can be asked may be quite limited. This in turn limits the information obtainable from the data with regard to the preferences of different age groups, socioeconomic groups, etc.

Material

1. Sample
   - A commercial banana fig from different company
     - Sun Flower Brand
     - Ang Tong Brand
     - Kuaw Tak Tammachat Brand
     - Kun Ying Brand
     - Flower Food Brand
     - Suanchitrada Brand
   - A banana fig from the developed process
     - 2.5% Salt
     - 2.5% Salt and 20% Glucose Syrup
2. Material for Sensory Evaluation
   - Equipment in sensory test
   - Questionnaire

3. Equipment in Sensory Analysis
   - Micro Computer
   - SPSS Program

Method

1. Consumer Survey

Consumers who are 18-35 years old for 40 persons do the questionnaires. Men and Women did them equally. The information that consumers are explored about consumer's buying and consumption behavior of dried banana fig product, brand, price and package. Then SPSS Program is used to analyze the data.

2. Defining a Reference Product

Dried banana figs from 4 sources are chosen by 40 consumers who are 18-35 years old and using hedonic score (1= dislike extremely, 9= like extremely) to test preference. A source that got the highest score as a reference product that will be used for training panelists.

3. Sensory Evaluation of Banana Fig

3.1 Selecting Panelists

Interview first to scan panelists then selected 8 panelists by Triangle Test in Descriptive Analysis method.

3.2 Training Panelists

A prototype is prepared from commercially available samples an array of products as a frame of reference, which represents as many as possible of the attribute differences likely to be encountered in the product category. The panel is first introduced to the chemical and physical principles, which influence the perception of each product attribute. With these concepts and terms as a foundation, the panel then develops procedures for evaluation and terminology with definitions and references for the product class.

The scaling method of choice is introduced by using a reference product. The continued use of intensity reference scales during practice is meant to provide continued reinforcement of both attributes and intensities.

The panels continue to test and describe a reference product to gain confidence both as individuals and as a group. The interaction after each session and discuss results is done for developing the common terminology, procedures for evaluation, and scaling techniques which characterize a finely tuned sensory instrument.

3.3 Sensory Evaluation of Target Product

Eight trained panelists are presented with these difference sources of dried banana fig: a reference product, two target products from developed process, and two commercially products on a tray and ask to judge the samples for 18 attributes (color, evenness, brightness, burned odor, fermented odor, ripen banana odor, sweeten odor, softness, denseness, sweetness, saltiness, sourness, ripen banana flavor, fermented flavor, sweeten flavor, after taste-bitter, after taste-sweetness, after taste-ripen banana) on a 0-15 scale. Then these data are analyzed with SPSS program.

Result and Discussion

1. Consumer Survey

Table2: Information about Consumer's Demographic Data

Factor	Frequency (%)
Sex	
Male	50
Female	50
Age	
15 – 20 years	25
21 – 25 years	25
26 - 30 years	25
31 – 35 years	25
Education	
Lower than high school	2.5
High school	7.5
Bachelor degree	85
Higher than Bachelor degree	5
Occupation	
Student	42.5
Employee	47.5
Business	2.5
Housewife	7.5
Salary /month (baht)	
Less than 5,000	32.5
5,001 – 10,000	30
10,001 – 15,000	25
15,001 – 20,000	5
20,001 – 25,000	7.5
More than 25,000	0

Table 3: Information about Consumer's Consumption Behavior of Dried Banana Fig Product

Factor	Frequency (%)
Likeliness	
Like	75
Dislike	25
Brand	
A preferred brand	12.5
No preferred brand	87.5
Consumption /month	
Less than 1 time	55
1 - 3 times	30
4 – 6 times	7.5
More than 6 times	7.5

Table 4: Information about Consumer's Buying Behavior of Dried Banana Fig Product

Factor	Frequency (%)
A suitable package	
Transparent plastic box	87.5
Transparent plastic bag	5
Laminated plastic pouch	7.5
Cost / a box	
10 – 25 baht	37.5
26 – 40 baht	60
41 – 55 baht	2.5
Buying Place	
Supermarket	32.5
Festival fair	37.5
Restaurant	15
Other	15
Factor in buying	
Product-characters	27.21
Package	16.18
Price	19.12
Brand	3.68
Easy to buy	15.44
Easy to eat	16.18
Other	2.21

Table 5: Important factor that influent buying

Order	Factor
1[c]	Wholesomeness
2[a]	Tenderness
3[a]	Flavor
4[a]	Color
5[a]	Odor
6[ab]	Sweetness
7[ab]	Shape
8[b]	Stickiness when touch

The result was found out, which the most important attribute is wholesomeness, the second is tenderness, and the third is flavor. So tenderness and flavor were particularly interested in sensory evaluation.

2. Defining a Reference Product

Four different dried banana figs varieties were Flower Food, Luang Wang, Kuaw Tak Tammachat, and Kun Ying brand. These dried banana figs were presented in randomized order and evaluated for their appearance as well as their general liking on a nine-point scale ("like very much" = 9). Each individual fruit tested by the consumers questioned was subsequently characterized for its color, odor, texture, sweetness, flavor, and overall.

Table 6: Sensory Evaluation of different commercial brands

Brand	Color	Odor	Texture	Sweeten	Flavor	Overall
Flower Food	6.05±1.81[b]	6.03±1.18[ab]	5.7±1.55[b]	6.13±1.48[b]	6.18±1.25[b]	6.18±1.20[b]
Luang Wang	7.90±1.08[c]	7.08±1.53[c]	7.18±1.41[c]	7.00±1.63[c]	6.85±1.61[b]	7.35±1.33[c]
Kuaw Tak Tammachat	5.68±1.58[ab]	6.45±1.16[bc]	6.2 ±1.35[b]	6.30±1.35[bc]	6.20±1.53[b]	6.38±1.49[b]
Kun Ying	5.18±1.98[a]	5.63±1.82[a]	4.65±1.85[a]	5.20±1.95[a]	5.38±1.88[a]	5.45±1.89[a]

Note: *The results with the same letter designated no statistically significant difference, at 95% confidence level.*

From the table, Luang Wang was chosen as a reference product because it got the highest score and was significant difference from each other in each attribute.

3.2 Training Panelist

Luang Wang brand, a reference product was presented to panels. The panel has a determined opinion about which quality traits are important in a dried banana fig. The panel was allowed to choose, as many traits or attributes as they felt were important. Those attributes were brown color, evenness, brightness, burned odor, fermented odor, ripen banana odor, sweeten odor, softness, denseness, saltiness, sourness, ripen banana flavor, fermented flavor, sweeten flavor, after taste-bitter, after taste-sweetness, and after taste-ripen banana. And these descriptive attributes could be used to design the questionnaire. The questionnaire and a reference product were used to train using a scale and to familiarize the selected panelists with test procedures; improve an individual's ability to recognize and identify sensory attributes; and improve an individual's sensitivity and memory of these attributes. The panel was trained for 5 times until the standard deviation decrease to less than 2. The result was shown in Figure 1. Evaluation is carried out after completion of the training phase to establish the reliability and validity of the panel results.

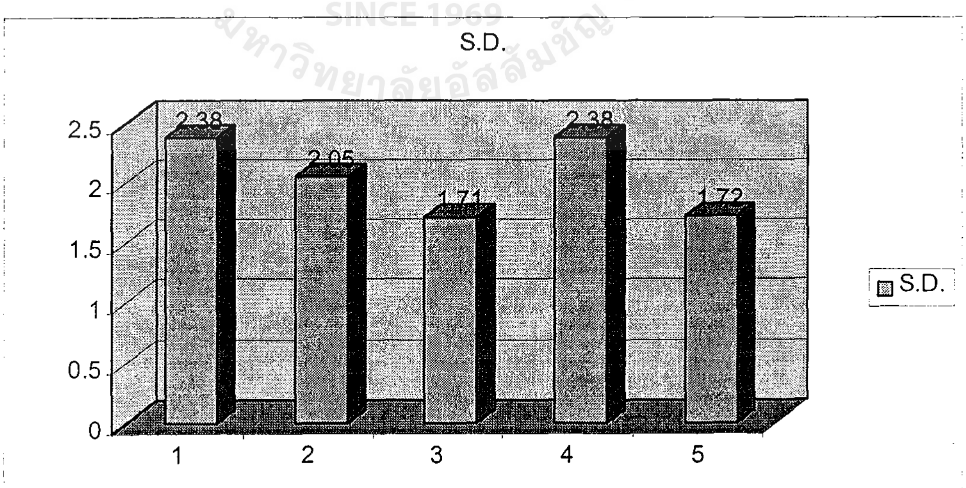

Figure6: The standard deviation value in each time of training panel

3.3 Sensory Evaluation of Target Product

Mean values for each of the attributes and for different dried banana fig varieties are given in Figure 2, 3, 4. Looking at them more closely, there were no difference significant in burnt, burned odor, fermented odor, ripen banana odor, saltiness, sourness, astringent aftertaste, and ripened banana aftertaste.

From Descriptive test by eight trained panels, it was found that 2.5% salt and 20% glucose syrup treatment give the brown color attribute as same level as a reference, Luangwang brand, while 25% salt treatment give this attribute higher than the reference and it also give the same level as Flower Food brand.

Another attribute, which give the significant difference, is brightness attribute. Both treatments and Flower Food brand show that their brightness the same level as the reference while Suanchitrada brand give the lowest level in the brightness.

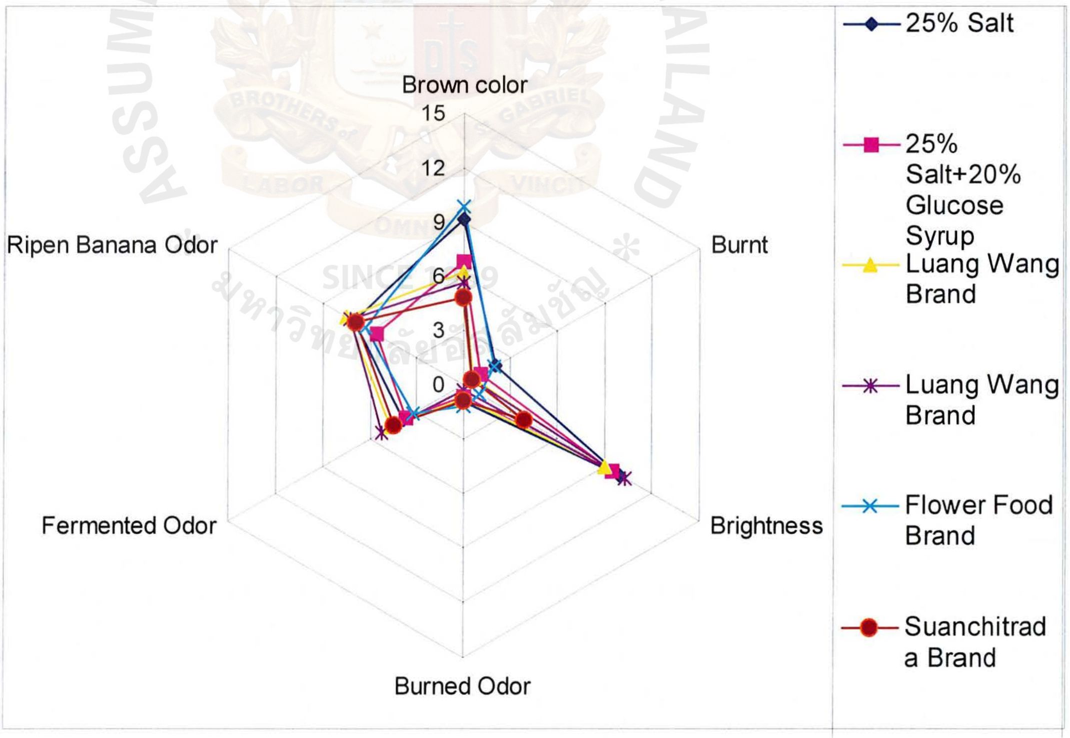

Figure 7: The spider web show the result of each attribute in sensory evaluation

The result of sweeten odor can be divided into 3 groups the highest intensity was Luangwang brand (a reference), the following level was Suanchitrada brand and 2.5% salt and 20% glucose syrup, and 2.5 salt lowest was Flower Food brand. Resulted show that softness of all samples was significantly difference on the other hand. As well as the result of denseness, denseness can be divided into 3 groups follows the highest intensity was Suanchitrada, the second order was 2.5% salt and 20% glucose syrup, Luangwang brand, and the lowest was 2.5% salt and Flower Food brand. And the result from sweetness can be divided into 2 groups: the highest intensity was Luangwang brand, 2.5% salt and 20% glucose syrup, 2.5% salt. And the lowest was Suanchitrada and Flower Food brand.

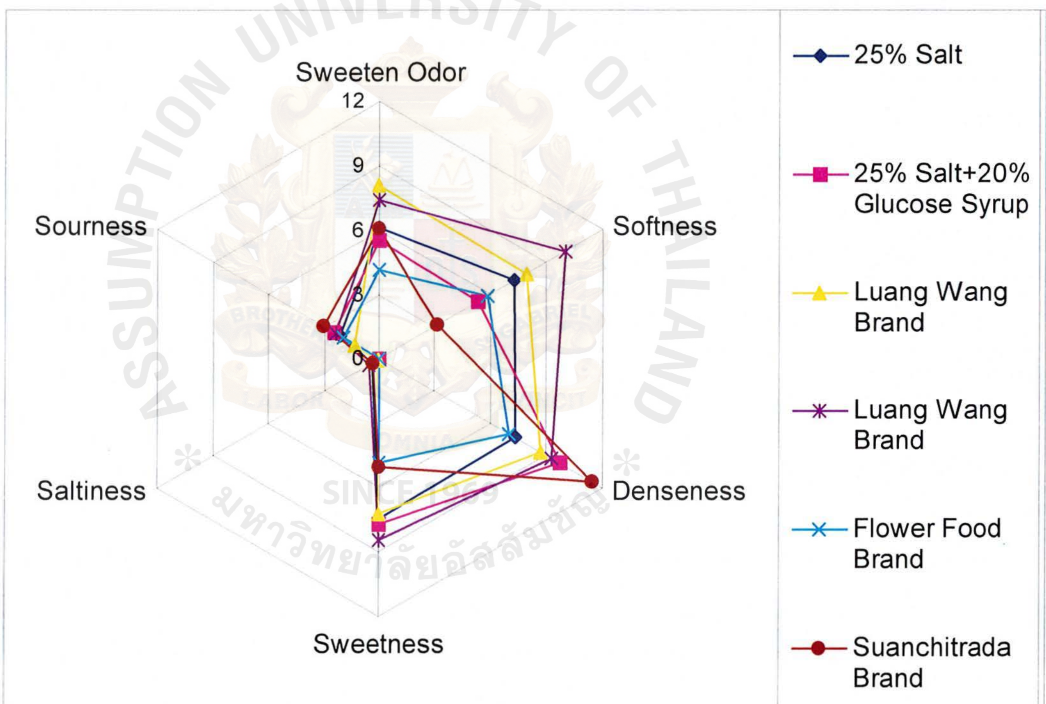

Figure 8: The spider web show the result of each attribute in sensory evaluation

From the flavor descriptive test, it was found that ripen banana flavor of all treatment give the lower level than the reference. In fermented flavor test, the reference gave the highest level, the followings are both treatments, Flower Food, and Suanchitrada brand, respectively. In sweeten flavor, was shown obviously difference compared with other attributes. The reference also showed the highest in sweeten flavor. Both the reference and developed product from the research had much more sweeten flavor than the other commercial product. Whereas these two developed products are nearly the same as the reference product. It imply that by soaking in the bine, banana flavor can develop the sweeten flavor in the final product compared with commercial products.

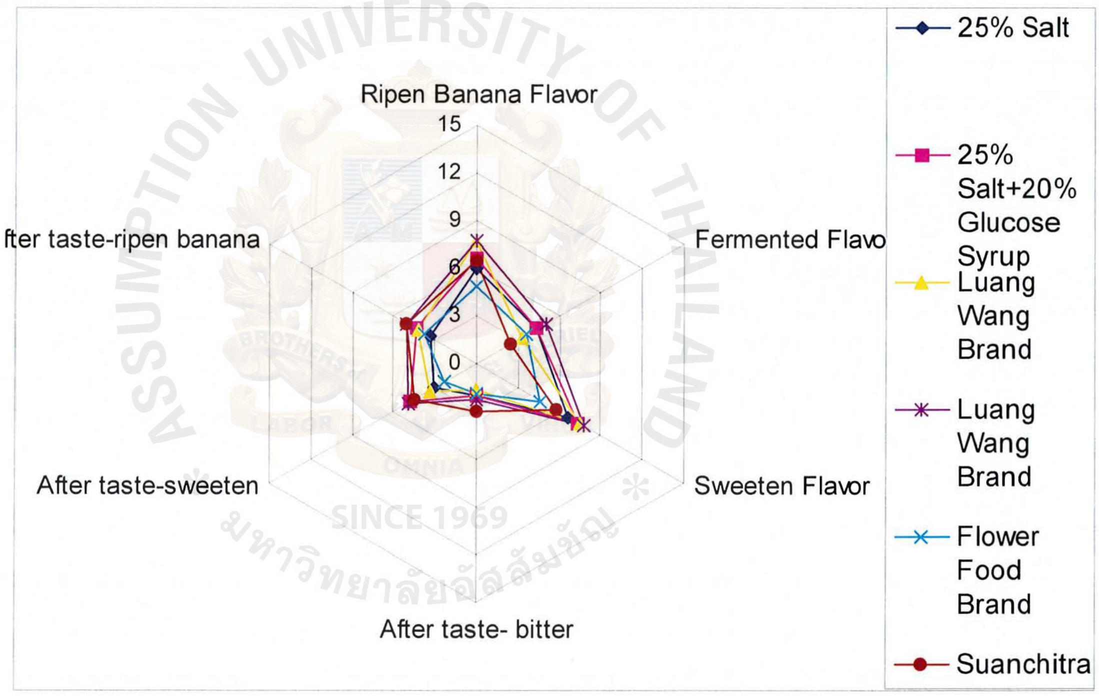

Figure 9: The spider web shows the result of each attribute in sensory evaluation

Conclusion

1. Consumer Survey

From consumer survey (n=40), the consumer consumes banana figs less than a time per month. The package should be a transparent plastic box. The price/ 500g should be 26-40 baht. Most consumers have no favorite brand. Factor in decision to buy the product is product characteristic. And the important product character is wholesomeness.

2. Defining a reference product

Luangwang is a brand that is preference and accepted for consumers so it is used as a reference product.

3. Training Panelist

The eight trained panels is trained to familiar with these affected 18 attributes:

- Brown color
- Burnt
- Brightness
- Burned Odor
- Fermented Odor
- Ripen Banana Odor
- Sweeten Odor
- Softness
- Denseness
- Sweetness
- Saltiness
- Sourness
- Sourness
- Ripen Banana Flavor
- Fermented Banana Flavor
- Sweeten Flavor
- Astringent Aftertaste
- Sweetness Aftertaste
- Ripen Banana Aftertaste

4. Sensory Evaluation of Developed Products

From the descriptive test, there are no different significant in these attributes: burnt, burned odors, fermented odor, ripen banana odor, saltiness, sourness, astringent aftertaste, and ripened banana aftertaste.

For 2.5% NaCl, It was over brown color, burnt, and fermented flavor. It was low sweetening odor, denseness and ripen banana flavor. And it was nearly with a reference in brightness, fermented odor, ripen banana odor, softness, sweetness, sourness, sweeten flavor, astringent aftertaste, sweeten aftertaste, ripen banana aftertaste.

For 2.5% NaCl and 20% Glocose syrup, It was over fermented flavor and sweeten aftertaste. It was low sweetens odor and softness. And it was near a reference in brown color, brightness, fermented odor, ripen banana odor, densesness, sweetness, ripen bnanana flavor, and sweeten flavor.

References

http://www.da.gov.ph/tips/banana.html

http://www.uga.edu/fruit/banana.htm#harvest

Amerine, M.A., Pangborn, R.M., and Roessler, E.B., 1965. *Principles of Sensory Evaluation of Food.* Academic Press, New York, 602 pp.

McDougall, D.B., 1983. Assessment of the appearance of food. In: *Sensory Quality in Foods and Beverages: Its Definition, Measurement and Control,* Williams, A.A. and Atkin, R.K., Eds. Ellis Horwood, Chichester/Verlag Chemie, Deerfield Beach, p.121 ff.

Clydesdale, F.M., 1984. Color measurement. In: *Food Analysis. Principles and Techniques,* Vol. 1, Gruenwedel, D.W. and Whitaker, J.R., Eds. Marcel Dekker, New York, p. 95ff.

McDougall, D.B., 1988. Color vision and appearance measurement. In: *Sensory Analysis of Foods,* 2nd ed. Piggott, J.R., Ed. Elsevier, London, p.103ff.

Lawless, H.T. and Heymann, H., 1998. *Sensory Evaluation of Food. Principles and Practices.* Chapman & Hall, New York, 819 pp.

Laing, D.G., 1983. Natural sniffing gives optimum odor perception for humans. *Perception* 12, 99.

De Man, J.M., Voisey, P.W., Rasper, V.F., and Stanley, D.W., 1976. *Rheology and Texture in Food Quality.* AVI Publishing, Westport, CT.

Caul, J.F., 1957. The profile method of flavor analysis. *Adv. Food Res.* 7, 1.

Civille, G.V.and Lyon, B.G., Eds., 1996. *Aroma and Flavor Lexicon for Sensory Evaluation. Terms, Definitions, References, and Examples.* ASTM Data Series Publication DS 66, American Society for Testing and Materials, W. Conshohocken, PA, 158 pp. (plus diskette).

Kelly, F.B. and Heymann, H., 1989. Contrasting the effects of ingestion and expectoration in sensory difference tests. *J. Sensory Stud.* 3(4), 249.

Pangborn, R.M., 1984. Sensory techniques of food analysis. In: *Food Analysis. Principles and Techniques,* Vol. I: *Physical Characterization,* Gruenwedel, D.W. and Whitaker, J.R., Eds. Marcel Dekker, New York, p. 37ff; see pp. 61-68.

Friedman, M., 1937. The use of ranks to avoid the assumption of normality implicit in the Analysis of Variance. *J.Am. Stat. Assoc.* 32,675.

Kramer, A., Kahan, G., Cooper, D., and Papavasiliou, A., 1974. A non-parametric method for the statistical evaluation of Sensory data. *Chem. Senses Flavor* 1, 121.

Zook, K. and Wesmann, C., 1977. The selection and use of judges for descriptive panels. *Food Technol.* 31(11),56.

Civille, G.V., 1979. *Descriptive Analysis.* Course notes for IFT Short Course in Sensory Analysis. Institute of Food Technology, Chicago, Chapter 6.

Johnsen, P.B., Civille, G.V., Vercellotti, J.R., Sanders, T.H., and Dus, C.A., 1988. Development of a lexicon for description of peanut flavor. *J. Sensory Stud.* 3(1), 9.

Lawless, H.T. and Heymann, H., 1998. *Sensory Evaluation of Food. Principles and Practises.* Chapman & Hall, New York, Chapter 10.

Jelterma, M.A. and Southwick, E.W., 1986. Evaluation and application of odor profiling. *J. Sensory Stud.* 1(2), 123.

ISO, 1994. *Sensory-analysis—Identification and selection of descriptors for establishing a sensory profile by a multidimensional approach.* International Organization for Standardization, ISO 11035:1994, Availability, see p. 148.

Brandt, M.A., Skinner, E.Z., and Coleman, J.A., 1963. Texture profile method. *J. Food Sci.* 28(4), 404, 1963.

Schwartz, N., 1975. Method to skin car4e products. *J. Texture Stud.* 6, 33.

ASTM, 1997a. *Standard Practice for Descriptive Skinfeel Analysis of Creams and Lotions.* ASTM standard Practice E1490-92. American Society of Testing and Materials, West Conshohocken, PA.

Civille, G.V. and Dus, C.A., 1990. Development of terminology to describe the handfeel properties of paper and fabrics. *J. Sensory Stud.* 5, 19.

Civille, G.V. and Dus, C.A., 1991. Evaluating tactile properties of skincare products: a descriptive analysis technique. *Cosmetics and Toiletries* 106(5), 83.

Meilgaard, M.C., 1992. Basics of consumer testing with beer in North America. *Proc. Ann. Meet. Inst. Brew., Australia & New Zealand Sect.,* Melbourne, 37-47. See also *The New Brewer* 9(6), 20-25.

Resurreccion, A. V.A., 1998. *Consumer Sensory Testing for Product Development.* Aspen Publishers, Gaithersburg, MD, 254 pp.

Appendix A:

Defining a Reference Product

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: COLOR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	331.650[a]	42	7.896	3.020	.000
Intercept	6150.400	1	6150.400	2352.008	.000
TRT	169.550	3	56.517	21.613	.000
REP	162.100	39	4.156	1.589	.031
Error	305.950	117	2.615		
Total	6788.000	160			
Corrected Total	637.600	159			

a. R Squared = .520 (Adjusted R Squared = .348)

Post Hoc Tests

TRT

Homogeneous Subsets

COLOR

Duncan[a,b]

TRT	N	Subset 1	2	3
4.00	40	5.1750		
3.00	40	5.6750	5.6750	
1.00	40		6.0500	
2.00	40			7.9000
Sig.		.169	.302	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.615.

a. Uses Harmonic Mean Sample Size = 40.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: ODOR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	143.113[a]	42	3.407	1.346	.109
Intercept	6337.806	1	6337.806	2504.459	.000
TRT	46.169	3	15.390	6.081	.001
REP	96.944	39	2.486	.982	.510
Error	296.081	117	2.531		
Total	6777.000	160			
Corrected Total	439.194	159			

a. R Squared = .326 (Adjusted R Squared = .084)

Post Hoc Tests

TRT

Homogeneous Subsets

ODOR

Duncan[a,b]

TRT	N	Subset		
		1	2	3
4.00	40	5.6250		
1.00	40	6.0250	6.0250	
3.00	40		6.4500	6.4500
2.00	40			7.0750
Sig.		.263	.235	.082

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.531.

a. Uses Harmonic Mean Sample Size = 40.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: TEXTURE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	209.963[a]	42	4.999	1.587	.028
Intercept	5652.506	1	5652.506	1794.538	.000
TRT	133.719	3	44.573	14.151	.000
REP	76.244	39	1.955	.621	.955
Error	368.531	117	3.150		
Total	6231.000	160			
Corrected Total	578.494	159			

a. R Squared = .363 (Adjusted R Squared = .134)

Post Hoc Tests

TRT

Homogeneous Subsets

TEXTURE

Duncan[a,b]

TRT	N	Subset		
		1	2	3
4.00	40	4.6500		
1.00	40		5.7000	
3.00	40		6.2500	
2.00	40			7.1750
Sig.		1.000	.168	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 3.150.

a. Uses Harmonic Mean Sample Size = 40.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: SWEETEN

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	208.262[a]	42	4.959	1.682	.016
Intercept	6063.906	1	6063.906	2057.462	.000
TRT	65.919	3	21.973	7.455	.000
REP	142.344	39	3.650	1.238	.191
Error	344.831	117	2.947		
Total	6617.000	160			
Corrected Total	553.094	159			

a. R Squared = .377 (Adjusted R Squared = .153)

Post Hoc Tests

TRT

Homogeneous Subsets

SWEETEN

Duncan[a,b]

TRT	N	Subset 1	Subset 2	Subset 3
4.00	40	5.2000		
1.00	40		6.1250	
3.00	40		6.3000	6.3000
2.00	40			7.0000
Sig.		1.000	.649	.071

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.947.

a. Uses Harmonic Mean Sample Size = 40.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: FLAVOR

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	152.650[a]	42	3.635	1.163	.262
Intercept	6051.600	1	6051.600	1935.850	.000
TRT	43.750	3	14.583	4.665	.004
REP	108.900	39	2.792	.893	.649
Error	365.750	117	3.126		
Total	6570.000	160			
Corrected Total	518.400	159			

a. R Squared = .294 (Adjusted R Squared = .041)

Post Hoc Tests

TRT

Homogeneous Subsets

FLAVOR

Duncan[a,b]

TRT	N	Subset 1	Subset 2
4.00	40	5.3750	
1.00	40		6.1750
3.00	40		6.2000
2.00	40		6.8500
Sig.		1.000	.109

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 3.126.

a. Uses Harmonic Mean Sample Size = 40.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: OVERALL

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	196.400[a]	42	4.676	1.780	.008
Intercept	6426.225	1	6426.225	2446.095	.000
TRT	73.625	3	24.542	9.342	.000
REP	122.775	39	3.148	1.198	.229
Error	307.375	117	2.627		
Total	6930.000	160			
Corrected Total	503.775	159			

a. R Squared = .390 (Adjusted R Squared = .171)

Post Hoc Tests

TRT

Homogeneous Subsets

OVERALL

Duncan[a,b]

TRT	N	Subset		
		1	2	3
4.00	40	5.4500		
1.00	40		6.1750	
3.00	40		6.3750	
2.00	40			7.3500
Sig.		1.000	.582	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.627.

a. Uses Harmonic Mean Sample Size = 40.000.

b. Alpha = .05.

Appendix B:

Sensory Evaluation of Target Product

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00001

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	252.392[a]	12	21.033	8.706	.000
Intercept	2399.841	1	2399.841	993.343	.000
TRT	162.254	5	32.451	13.432	.000
REP	90.138	7	12.877	5.330	.000
Error	84.557	35	2.416		
Total	2736.790	48			
Corrected Total	336.949	47			

a. R Squared = .749 (Adjusted R Squared = .663)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00001

Duncan[a,b]

TRT	N	Subset		
		1	2	3
6	8	4.7875		
5	8	5.6063	5.6063	
3	8	6.2125	6.2125	
2	8		6.8063	
1	8			9.1500
4	8			9.8625
Sig.		.091	.153	.366

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.416.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00002

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	99.047[a]	12	8.254	3.497	.002
Intercept	61.088	1	61.088	25.881	.000
TRT	19.366	5	3.873	1.641	.175
REP	79.681	7	11.383	4.823	.001
Error	82.613	35	2.360		
Total	242.748	48			
Corrected Total	181.660	47			

a. R Squared = .545 (Adjusted R Squared = .389)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00002

Duncan[a,b]

TRT	N	Subset
		1
6	8	.5125
5	8	.5250
3	8	.6500
2	8	1.1250
4	8	1.9313
1	8	2.0250
Sig.		.091

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.360.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00003

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	694.390[a]	12	57.866	14.133	.000
Intercept	2534.613	1	2534.613	619.032	.000
TRT	602.409	5	120.482	29.425	.000
REP	91.981	7	13.140	3.209	.010
Error	143.307	35	4.094		
Total	3372.310	48			
Corrected Total	837.697	47			

a. R Squared = .829 (Adjusted R Squared = .770)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00003

Duncan[a,b]

TRT	N	Subset		
		1	2	3
4	8	.9813		
6	8		3.8938	
3	8			8.9438
2	8			9.4688
1	8			9.9875
5	8			10.3250
Sig.		1.000	1.000	.222

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 4.094.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00004

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	59.395[a]	12	4.950	2.359	.024
Intercept	28.753	1	28.753	13.704	.001
TRT	3.529	5	.706	.336	.887
REP	55.866	7	7.981	3.804	.004
Error	73.435	35	2.098		
Total	161.582	48			
Corrected Total	132.830	47			

a. R Squared = .447 (Adjusted R Squared = .258)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00004

Duncan[a,b]

TRT	N	Subset
		1
5	8	.2750
2	8	.6625
3	8	.7500
6	8	.8750
1	8	.9250
4	8	1.1563
Sig.		.295

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.098.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00005

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	320.526[a]	12	26.711	11.375	.000
Intercept	817.163	1	817.163	347.987	.000
TRT	21.382	5	4.276	1.821	.134
REP	299.145	7	42.735	18.199	.000
Error	82.189	35	2.348		
Total	1219.878	48			
Corrected Total	402.715	47			

a. R Squared = .796 (Adjusted R Squared = .726)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00005

Duncan[a,b]

TRT	N	Subset 1	Subset 2
4	8	3.1625	
2	8	3.6500	3.6500
1	8	3.8000	3.8000
6	8	4.3750	4.3750
3	8	4.5688	4.5688
5	8		5.2000
Sig.		.109	.078

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.348.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00006

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	263.367[a]	12	21.947	6.541	.000
Intercept	2189.025	1	2189.025	652.437	.000
TRT	19.907	5	3.981	1.187	.336
REP	243.460	7	34.780	10.366	.000
Error	117.430	35	3.355		
Total	2569.822	48			
Corrected Total	380.797	47			

a. R Squared = .692 (Adjusted R Squared = .586)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00006

Duncan[a,b]

TRT	N	Subset 1
2	8	5.5688
4	8	6.2688
6	8	6.9250
1	8	7.0438
5	8	7.2875
3	8	7.4250
Sig.		.082

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 3.355.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00007

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	205.710[a]	12	17.143	4.144	.000
Intercept	1869.379	1	1869.379	451.920	.000
TRT	77.860	5	15.572	3.765	.008
REP	127.850	7	18.264	4.415	.001
Error	144.778	35	4.137		
Total	2219.868	48			
Corrected Total	350.488	47			

a. R Squared = .587 (Adjusted R Squared = .445)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00007

Duncan[a,b]

TRT	N	Subset		
		1	2	3
4	8	4.1563		
2	8	5.5375	5.5375	
6	8	6.0938	6.0938	6.0938
1	8	6.1313	6.1313	6.1313
5	8		7.4250	7.4250
3	8			8.1000
Sig.		.083	.098	.079

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 4.137.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00008

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	372.287[a]	12	31.024	4.349	.000
Intercept	2066.531	1	2066.531	289.674	.000
TRT	220.075	5	44.015	6.170	.000
REP	152.212	7	21.745	3.048	.013
Error	249.689	35	7.134		
Total	2688.507	48			
Corrected Total	621.976	47			

a. R Squared = .599 (Adjusted R Squared = .461)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00008

Duncan[a,b]

TRT	N	Subset		
		1	2	3
6	8	3.1813		
2	8	5.2750	5.2750	
4	8	5.8125	5.8125	
1	8		7.2375	7.2375
3	8		7.8875	7.8875
5	8			9.9750
Sig.		.070	.081	.059

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 7.134.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00009

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	174.488[a]	12	14.541	2.502	.017
Intercept	3788.742	1	3788.742	651.923	.000
TRT	107.238	5	21.448	3.690	.009
REP	67.250	7	9.607	1.653	.153
Error	203.407	35	5.812		
Total	4166.638	48			
Corrected Total	377.896	47			

a. R Squared = .462 (Adjusted R Squared = .277)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00009

Duncan[a,b]

TRT	N	Subset 1	Subset 2
4	8	6.9625	
1	8	7.3188	
3	8	8.6875	
5	8	9.2438	9.2438
2	8	9.6625	9.6625
6	8		11.4312
Sig.		.051	.094

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 5.812.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00010

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	418.490[a]	12	34.874	6.734	.000
Intercept	2214.083	1	2214.083	427.520	.000
TRT	88.274	5	17.655	3.409	.013
REP	330.217	7	47.174	9.109	.000
Error	181.261	35	5.179		
Total	2813.835	48			
Corrected Total	599.752	47			

a. R Squared = .698 (Adjusted R Squared = .594)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00010

Duncan[a,b]

TRT	N	Subset 1	Subset 2	Subset 3
4	8	4.8437		
6	8	5.0625	5.0625	
3	8	7.1938	7.1938	7.1938
1	8		7.4750	7.4750
2	8			7.7250
5	8			8.4500
Sig.		.058	.051	.323

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 5.179.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00011

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5.972[a]	12	.498	1.329	.246
Intercept	2.660	1	2.660	7.106	.012
TRT	2.552	5	.510	1.363	.262
REP	3.421	7	.489	1.305	.277
Error	13.103	35	.374		
Total	21.735	48			
Corrected Total	19.075	47			

a. R Squared = .313 (Adjusted R Squared = .078)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00011

Duncan[a,b]

TRT	N	Subset 1
2	8	.0000
4	8	.0000
3	8	.0563
6	8	.3438
1	8	.4125
5	8	.6000
Sig.		.092

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .374.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00012

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	197.391[a]	12	16.449	3.450	.002
Intercept	229.250	1	229.250	48.077	.000
TRT	13.169	5	2.634	.552	.735
REP	184.222	7	26.317	5.519	.000
Error	166.894	35	4.768		
Total	593.535	48			
Corrected Total	364.285	47			

a. R Squared = .542 (Adjusted R Squared = .385)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00012

Duncan[a,b]

TRT	N	Subset
		1
3	8	1.2750
4	8	1.9500
1	8	2.1125
5	8	2.3125
2	8	2.4625
6	8	3.0000
Sig.		.174

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 4.768.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00013

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	176.680[a]	12	14.723	4.583	.000
Intercept	2104.763	1	2104.763	655.196	.000
TRT	48.994	5	9.799	3.050	.022
REP	127.686	7	18.241	5.678	.000
Error	112.435	35	3.212		
Total	2393.878	48			
Corrected Total	289.115	47			

a. R Squared = .611 (Adjusted R Squared = .478)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00013

Duncan[a,b]

TRT	N	Subset 1	Subset 2
4	8	4.9188	
1	8	5.9688	5.9688
6	8	6.5625	6.5625
2	8	6.6750	6.6750
3	8		7.8000
5	8		7.8063
Sig.		.081	.074

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 3.212.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00014

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	337.391[a]	12	28.116	10.384	.000
Intercept	708.403	1	708.403	261.637	.000
TRT	33.630	5	6.726	2.484	.050
REP	303.761	7	43.394	16.027	.000
Error	94.765	35	2.708		
Total	1140.560	48			
Corrected Total	432.157	47			

a. R Squared = .781 (Adjusted R Squared = .706)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00014

Duncan[a,b]

TRT	N	Subset 1	Subset 2
6	8	2.5313	
3	8	3.1937	
4	8	3.5688	3.5688
2	8	4.3375	4.3375
1	8	4.3625	4.3625
5	8		5.0563
Sig.		.053	.107

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.708.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00015

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	223.577[a]	12	18.631	4.839	.000
Intercept	2084.944	1	2084.944	541.519	.000
TRT	61.919	5	12.384	3.216	.017
REP	161.658	7	23.094	5.998	.000
Error	134.756	35	3.850		
Total	2443.277	48			
Corrected Total	358.333	47			

a. R Squared = .624 (Adjusted R Squared = .495)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00015

Duncan[a,b]

TRT	N	Subset	
		1	2
4	8	4.5688	
6	8	5.7250	5.7250
1	8	6.5688	6.5688
2	8		7.4063
3	8		7.4875
5	8		7.7875
Sig.		.061	.067

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 3.850.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00016

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	129.921[a]	12	10.827	7.018	.000
Intercept	214.884	1	214.884	139.293	.000
TRT	9.102	5	1.820	1.180	.339
REP	120.819	7	17.260	11.188	.000
Error	53.994	35	1.543		
Total	398.799	48			
Corrected Total	183.915	47			

a. R Squared = .706 (Adjusted R Squared = .606)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00016

Duncan[a,b]

TRT	N	Subset
		1
3	8	1.6563
4	8	1.8188
1	8	1.9625
2	8	1.9875
5	8	2.2750
6	8	2.9950
Sig.		.065

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1.543.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00017

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	168.397[a]	12	14.033	5.550	.000
Intercept	687.053	1	687.053	271.703	.000
TRT	43.382	5	8.676	3.431	.013
REP	125.016	7	17.859	7.063	.000
Error	88.504	35	2.529		
Total	943.955	48			
Corrected Total	256.902	47			

a. R Squared = .655 (Adjusted R Squared = .537)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00017

Duncan[a,b]

TRT	N	Subset		
		1	2	3
4	8	2.3000		
1	8	3.0438	3.0438	
3	8	3.3313	3.3313	3.3313
6	8		4.4438	4.4438
2	8		4.7375	4.7375
5	8			4.8438
Sig.		.229	.058	.090

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2.529.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: VAR00018

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	173.267[a]	12	14.439	7.753	.000
Intercept	878.513	1	878.513	471.720	.000
TRT	16.966	5	3.393	1.822	.134
REP	156.301	7	22.329	11.989	.000
Error	65.183	35	1.862		
Total	1116.962	48			
Corrected Total	238.450	47			

a. R Squared = .727 (Adjusted R Squared = .633)

Post Hoc Tests

TRT

Homogeneous Subsets

VAR00018

Duncan[a,b]

TRT	N	Subset	
		1	2
1	8	3.4250	
4	8	3.7000	3.7000
3	8	4.1625	4.1625
2	8	4.3875	4.3875
6	8		4.9875
5	8		5.0063
Sig.		.207	.095

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1.862.

a. Uses Harmonic Mean Sample Size = 8.000.

b. Alpha = .05.

Questionnaires for Sensory Evaluation

Questionnaire

Determination of The Banana Fig's Sensory Quality

To: Panelists

Subject: Operation in Answering the questionnaire about Dried Banana Fig product

This questionnaire is a part of Ms. Chutima Makim's project who is a student of biotechnology faculty in Assumption University. The project is studied about "Sensory attributes index of Dried Banana Fig" that it is necessary to your cooperation in answering this questionnaire to be useful for the project. Finally, thank you for your cooperation.

A dried banana fig product is studied to be useful for general people who are interested to use in their occupation or their research. And the project is useful for assuring the product quality.

Thank you

Ms. Chutima Makim
Researcher

Instruction Please consider and answer all questions by checking the symbol / in the blank ( ).

Part 1 Demographic Data

1. Sex □A
   ( ) Male ( ) Female

2. Age □B
   ( ) 15-20 years ( ) 21-25 years
   ( ) 26-30 years ( ) 31-35 years

3. Education □C
   ( ) Lower than high school ( ) High school
   ( ) Bachelor degree ( ) Higher than Bachelor degree

4. Occupation □D
   ( ) Student ( ) Employee
   ( ) Business ( ) Housewife
   ( ) Other (please specify)...........

5. Salary per month (baht) □E
   ( ) Less than 5,000 ( ) 5,000-10,000
   ( ) 10,001-15,000 ( ) 15,001-20,000
   ( ) 20,001-25,000 ( ) More than 25,000

Part2 Information about consumer's buying and consumption Behavior of Dried Banana Fig product

6. Do you like a dried banana fig? □F
   ( ) Yes ( ) No

7. Do you have any preferred brand? ( ) Yes ( ) No □G
   If yes, what is it? ....

8. Where did you buy the product? □H
   ( ) Supermarket ( ) Restaurant
   ( ) Festival fair ( ) Other(please specify)........

9. How often do you eat the product in a month? □I

( ) Less than 1 time
( ) 1-3 times
( ) 4-6 times
( ) More than 6 times
( ) Occasionally

10. What package do you prefer? □J

( ) Transparent plastic box
( ) Transparent plastic bag
( ) Laminated plastic pouch

11. How much did you spend for this product per a package? □K
...............baht.

12. What factors do you use in buying the product? (You can answer more than one)

( ) Product-characters □L1
( ) Package □L2
( ) Price □L3
( ) Brand □L4
( ) Easy to buy □L5
( ) Easy to eat □L6
( ) Sale □L7

13. Please rank the important character of banana fig that you like in in an order from high(1) to low(8).

( ) Color □M1
( ) Wholesomeness □M2
( ) Shape □M3
( ) Odor □M4
( ) Tenderness □M5
( ) Sweet □M6
( ) Flavor □M7
( ) Stickiness when touch □M8

Part3 Sensory Evaluation of

A Dried Banana Fig Questionnaire

- Please rinse your mouth before starting.
- Evaluate the product in front of you by looking at them and tasting them.
- Considering *All* characteristics (Appearance, Flavor, and Texture) indicate how much you Like or Dislike by using these following score:

9 = Like extremely
8 = Like strongly
7 = Like very well
6 = Like fairly well
5 = Neither like nor dislike
4 = Like slightly
3 = Dislike slightly
2 = Dislike moderately
1 = Dislike intensely

Product Code	Color	Overall Odor	Overall Texture	Sweet	Overall Flavor	Overall

Triangle Test

Name__________________________________Date___________

Type of Sample____

Instructions

Taste samples from left to right. Two are identical: determine which is the odd sample.

If no difference is apparent, you must guess.

Set of three sample	Which is the odd sample?	Comments
_____ _____ _____	_____	__________
_____ _____ _____	_____	__________
_____ _____ _____	_____	__________

ใบรายงานผลการทดสอบกล้วยตาก

ตัวอย่าง กล้วยตาก

ชื่อผู้ทดสอบ____วันที่ ____________

กำแนะนำ : ทดสอบตัวอย่างจากซ้ายไปขวา ให้คะแนนความเข้มข้นของคุณลักษณะทางประสาทสัมผัสของกล้วยตาก โดยทำเครื่องหมาย "1 " บน สเกลคะแนนที่กำหนดต่อไปนี้ และกรุณาบ้วนปากก่อนทดสอบตัวอย่าง

สีน้ำตาล

อ่อน ———————————————— เข้ม

รอยไหม้

น้อย ———————————————— มาก

มันวาว

น้อย ———————————————— มาก

กลิ่นไหม้

อ่อน ———————————————— เข้ม

กลิ่นหมัก

อ่อน ———————————————— เข้ม

กลิ่นกล้วย

อ่อน ———————————————— เข้ม

กลิ่นน้ำผึ้ง/น้ำตาล

อ่อน　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　เข้ม

เนื้อนุ่ม

น้อย　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　มาก

เนื้อแน่น

น้อย　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　มาก

รสหวาน

น้อย　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　มาก

รสเค็ม

น้อย　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　มาก

รสเปรี้ยว

น้อย　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　มาก

กลิ่นรสกล้วย

อ่อน　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　เข้ม

กลิ่นรสหมัก

อ่อน　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　เข้ม

กลิ่นรสน้ำผึ้ง/น้ำตาล

อ่อน เข้ม

After taste - ฝาด

น้อย มาก

After taste - หวาน

น้อย มาก

After taste- กล้วย

อ่อน เข้ม