

# *Sensory Evaluation Optimization Techniques for Reduced-Fat Products*

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## Abstract

Mathematical models for predicting consumer preference behavior can be obtained using product optimization techniques from sensory evaluation. These techniques include the use of Quantitative Descriptive Analysis (QDA), central location testing with target consumers, analytical testing of all products, and extensive multivariate analysis.

When testing with full calorie, low-fat, and fat-free products, consumers may prefer products that are not included in their current purchase behavior. As consumer's tastes change, sensory evaluation techniques can be used to develop comprehensive optimization equations for formulating target products.

Product development and marketing can be provided with mathematical models for unique product characteristics important to consumer preference clusters, and products can be identified to assist product development in their formulation efforts of hitting the target more often and more precisely.

## Introduction

In the past several years, attention has focused on reduced-fat products in nearly every food category from potato chips and crackers to ice creams, cheeses, milk and dairy products, to frozen entrees and processed meats.

For reasons including health and nutrition, consumer interest initially was quite high in many product categories, prompting better than expected initial trial. However, repeat purchase was generally much lower than expected. Although consumers have been, and continue to be, willing to try reduced-fat products, many consumers determined that there were too many negatives in product performance (e.g., appearance, flavor and texture).

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As consumer tastes change and technology improves, it is becoming increasingly important to understand and optimize products based on consumer expectations (Garvin 1987). Product development can no longer be expected to formulate reduced-fat products that are similar to their full calorie versions, and must now formulate products targeted for specific populations. The mathematical models are used to define the unique preference behavior for those populations.

Efforts to optimize products are not new, nor are the use of consumers, trained panels, and multivariate analysis techniques used to achieve that objective (Schutz, 1983; Sidel and Stone, 1983). However, a systematic research design that provides more precise information than is possible with using any one of the procedures separately leads to targeted product development efforts (Hauser and Clausing, 1988; and Stone et al., 1991).

## Objectives

The first objective is to understand consumer preference behavior and to understand the degree to which optimum sensory acceptance has been achieved within the current product array of company and competitive products. If an optimal formulation has already been achieved, the company can focus resources on developing a different yet equally acceptable product.

The second objective is to identify the specific sensory attributes, ingredients or processes that will yield an optimal product. Since not all attributes are equally important, optimization research will identify the order of importance of the attributes.

The third objective is to determine if aggregate population preferences are homogeneous or if unique preference segments exist within the aggregate. The preference segments will be determined from consumers hedonic ratings and not from traditional demographic breakdowns of age, gender, income, region, etc. There is sufficient evidence that demographic segments do not correlate with unbranded preference behavior.

## Methods

To best understand the marketplace in sensory terms, a category review optimization is recommended with various components as follows:

## Product Selection

Prior to selecting products for inclusion in optimization research, it is recommended to consider and then evaluate as many products as possible (two hundred or more may be considered, and one hundred may be physically screened). Products may include current, pilot plant, plant-to-plant, and as many competitive and regional brands as possible. During the selection process, products are included based on marketing objectives, and then products that represent unique sensory characteristics are included to provide a comprehensive array.

## Sensory Analysis

A complete quantitative descriptive analysis (QDA) using a screened and trained panel is recommended for each product. The QDA method is well suited for optimization research (Stone et al., 1974; and Stone et al., 1980). QDA subjects provide consumer based (not technical expert based) language with complete definitions of terms and procedures for the evaluations. Each subject evaluates each product at least three times (replications) to provide a quantitative measure of product similarities and differences. Trained panel data are useful in absence of formulation and processing information, especially for competitive products.

## Analytical Testing

Analysis of the physical and chemical properties are conducted on all the products and typically represent a comprehensive evaluation.

## Consumer Acceptance

Approximately 100 consumers in each of three or more markets are recommended for these studies. Each of the consumers evaluate the acceptability of all products in the array, even if consecutive days are required. Acceptability measures are conducted using the nine-point hedonic scale.

Consumer qualification criteria should be directed at the target and potential target market, and are best developed as a team effort in conjunction with the marketing department and the advertising agency.

## Data Analysis

A broad range of univariate and multivariate analyses are used to determine significant differences among the products. The multivariate analyses provide equations for predicting consumer acceptance from the sensory and analytical evaluations, and to determine if unique preference segments exist within the aggregate population. QDA data are analyzed as described by Stone and Sidel (1993). Analysis of variance is used to determine differences among products, principal component analysis (PCA) is used for data reduction and to select predictive attributes for modeling. Cluster analysis is used for determining unique preference segments, and mul-

iple regression is used to develop the acceptance prediction equations used for the final optimization models for each unique preference segment.

## Discussion

Results from category review optimization research yield clear direction used by product developers to formulate products. This tool provides a common language between product development and marketing to understand the objectives of product formulation. The mathematical optimization models allow follow-up use of QDA information to assess the success of the reformulation efforts prior to validation research with consumers.

Using the consumer preference segments, marketing efforts are focused on determining potential areas of interest for members of the cluster segments. Consumers representing the basic demographic groups of age, gender, region of the country, and brand usage are easy to identify but are less useful in determining preference behavior. Consumers in the unique sensory preference segments typically represent different lifestyles and attitudes. Follow-up focus groups and interviews with the individuals from the preference segments are used to develop questionnaires that further differentiate these groups.

## Conclusions

Understanding product optimization techniques is useful in determining changes in consumer preference behavior in the low-fat and fat-free product areas. Consumer acceptance information can be used to develop mathematical models used by product developers for reformulation efforts. The overall objective of sensory optimization research is "to hit the target, to hit it soon and to hit it often. Although a successful optimization cannot guarantee success in the marketplace, it will point you in the right direction" (Stone, Sidel and Thomas, 1994).

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