

## Review

# Towards an integration of sensory research and marketing in new food products development: A theoretical and methodological review

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Product innovation can be instrumental for firms that want to be market oriented. There are many examples in the literature of the importance of sensory analysis in terms of designing, testing, launching, and rethinking food products. Sensory and product testing researchers have often called on to participate in the development of new products but they only quantified consumer reactions to prototypes developed and not in concept development at the early stage development phase. Lately sensory science seems to move towards market research and the sensory professional is required to become an expert in concept development at the early stages and not just in the measurement of sensory responses. Thus, this paper reviewed and categorised the most common methods of consumer research for sensory professional to participate, with an interdisciplinary approach to the different stages of New Product Development (NPD) process with the support of background information and the use of the latest researches in the field of consumer science. This review showed that some of these techniques may not have attained extensive adoption by product developers, because the conceptual bases, the theoretical constructs, and descriptive terminology associated with them are distant to product developers and their qualitative nature place them in conflict more quantitatively.

**Key words:** Consumer research, qualitative techniques, sensory analysis, product innovation.

## INTRODUCTION

Companies need to innovate in order to maintain market leadership. When the market is overloaded, the challenge is to create new products or update and reposition the existing products so that it can attract new consumers. The typical major stages in new product development (NPD) are opportunity identification, development, optimization and launch. Incorporating the voice of consumer in early stages of the new product development process has been identified as a critical success factor for new product development (Van Kleef et al., 2005). Consumer preference and choice derives from the interaction of all elements of the marketing mix. The implications of this statement are that an isolated taste test experiment in which other factors are not considered may be fitting the goal of measuring only the sensory effects of a food

sensory effects of a food product but it will not predict consumer choice. Also Coca Cola Company made these mistakes in marketing research for the launch of the "New Coke". The failure of the "New Coke" showed the importance of measuring the interaction among sensory aspects and the other elements of the marketing mix. The new cola, known as "New taste of Coke", was a major marketing failure. The new formulation was preferred in taste tests of nearly 200,000 consumers but in the marketing research methods, what developers did not consider was the bond consumers felt with Coke. The new Coke ran into problems when it replaced the older version because consumers do not buy a Coke for taste alone but they are buying also intangible attributes. Reasonable research efforts can, however, end up as a fiasco of massive proportions. More often than not the debacle is not big even if people only pay attention to the 'big ones' (Moskowitz, 2003). Problem is that conventional 'consumer' sensory analysis research done by Research and Development sensory analysts does

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not take into accounts the relevant marketing variables.

The importance to integrate sensory oriented research and marketing research techniques, in the design of the new products, comes from the failure of taste tests to predict the market performance of new food products even if sometimes this need has to deal with the inability of marketing researchers to perform such tests effectively (Ordonez, 2001; Armstrong and Kotler, 2000). Food scientists can make a contribution to the ability of food producers to conduct experiments planned to predict consumer preferences and choices. For these experiments it is important to consider the marketing context that will provide the necessary external validity considering not only the taste and other sensory attributes but also all the other product performance attributes which contribute to create the product perception and therefore, to predict consumer behaviour such as image, packaging, price, promotion, brand name. In sensory research the objective is to understand how individuals respond to exposure to sensory information whereas in consumer research the objective is to predict consumer purchase decisions in a dynamic, complex environment (Garber et al., 2003). Product innovation can be instrumental for firms that want to respond to changes in the business environment and to be market oriented. There are many examples in the literature of the importance of sensory analysis in terms of designing, testing, launching, and rethinking food products. When these tools are conceived of not only as a unique science but also jointly with other fields in marketing research, the interdisciplinary approach increases the potential and effectiveness of research and development. Thus, this paper reviews and categorises the most common methods in this area in terms of their key features, after having demonstrated the importance and the utility of adopting multiple methods and interdisciplinary approaches. We provide a guideline for the appropriateness of methods for sensory professional to participate in the different stages of NPD process with the support of background information and the use of the latest research in the field of consumer science.

## **SENSORY AND NON SENSORY ATTRIBUTES FOR FOOD PRODUCTS**

Sensory science is the science of quality perception. Quality is the requirement necessary to satisfy the needs and expectations of consumers (Peri, 2006). Hooker and Caswell (1996) identify the key quality sensory and non-sensory attribute subsets for food products in "quality attributes subsets": Food safety, nutrition, value, package process attributes. The first class of requirements in this scheme relates to safety such as the absence of food-borne pathogens, pesticide residues, and heavy metals, among others. Customer attention thus also focuses on

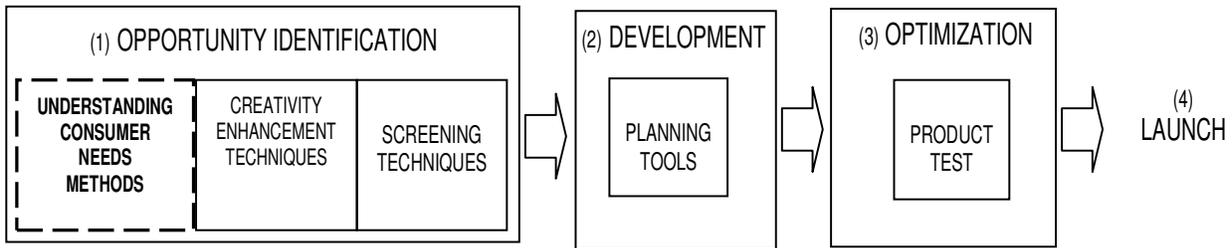
nutrition attributes related to conformity standards and recently in the food industry, innovations increasingly are based on nutritional requirements as for example happened with functional foods. The third class of requirements are value attributes that include purity, compositional integrity, size, appearance, taste and convenience and that are becoming of increasing interest for marketing experts.

Packaging attributes enable companies to communicate credible information about the quality of the food product. To support higher quality, it is necessary to communicate the uniqueness of products' attributes. Indications of the origin, the tradition of the production process, the use of organic agriculture, the animal welfare, the defence of the environment, and the presence of ethical requirements all play important roles in consumer choices. Of particular interest are the trade-offs between food properties and other sensory and non-sensory attributes, as well as their interactions (Cavicchi Simeone, et al., 2009). The quality dimensions should not be regarded as independent but there are interrelationships that vary from product to product: sometimes consumers perceive good taste and healthiness to be positively correlated and negatively correlated at other times. Consumer choices depend on consumer preferences affected by extrinsic and intrinsic characteristics. The intrinsic quality cues cover the physical characteristics of the product which can be measured objectively whereas the extrinsic quality cues represent the characteristics of the product such as brand name, distribution, price, packaging, product origin. Consumers use quality cues to infer the overall product quality: taste is sometimes perceived to be related to the process quality dimension, consumers use colour of meat to infer tenderness, or the consistency of yogurt to infer taste (Brunso et al., 2002). For that purpose it is necessary to innovate considering together all the aspects of food quality and how a change in one attribute can affect the other dimensions of quality.

## **THE INTEGRATION OF SENSORY RESEARCH IN THE OPPORTUNITY IDENTIFICATION STAGE OF NEW PRODUCT DEVELOPMENT: A CRITICAL REVIEW**

### **Selection of marketing research techniques for the incremental product innovation**

Van Kleef and her colleagues (2005) showed the four typical major stages in NPD with the most used consumer research methods for each stage. For their review, the authors selected the ten methods and techniques that are used most frequently (Jaeger, 2005) to uncover unmet consumer needs and wants. Starting from the original scheme proposed by Van Kleef and her colleagues, the study selected the consumer research methods used in the food research for incremental new product development and examined it through a literature review



### *In this review*

- Focus Group
- Conjoint Analysis
- Category Appraisal
- Kelly repertory grid
- Laddering
- Free Elicitation

Quality function deployment  
(House of Quality)

**Figure 1.** Selection of consumer research method from Van Cliff et al. (2005).

review which ones are the most used methods able to integrate the sensory aspects of products with the other marketing elements. Figure 1 illustrates the techniques selected in the “opportunity identification stage” used for incremental new product and in sensory consumer research, which are: conjoint analysis, focus group, free elicitation, Kelly repertory grid, laddering and category appraisal. Sensory research should have a key role in the product development effort. Its role is important for strategic and for practical reasons. Strategically, sensory information define how consumers perceive a product and therefore marketing plans on how to position the product, how the product competes with other products, what language to use to communicate to consumers. From a practical perspective, sensory research can identify product sensory deficiency not previously noted (Stone and Sidel, 2007). The best results are obtained when sensory research can be integrated with other marketing research techniques.

### **The integration of sensory research with other marketing research techniques**

In the following part, after discussing about each method used for incremental innovation of products, the study illustrated the main examples of how these methods might work to integrate sensory analysis with the other market elements in the early stage of product development.

#### **Focus groups**

Appeared in behavioural science research as an important tool for the qualitative research. In some works focus group are used to explore the different senses in

combination with a given marketing concept. It is preliminary to quantitative analysis and it can be supportive to know the relevant sensory characteristics the new product has to offer to please the target consumers. Focus group can be used alone or as an adjunct to another research method (Puchta and Potter, 2004). An interesting example comes from Raz et al. (2008) where focus groups are used to explore the different senses in conjunction with a given marketing concept and it is a pre-requisite for a quantification phase because it helped to know the relevant sensory characteristics the new product has to offer. They set up a protocol that aids in creating innovative products using a sensory marketing approach because the product has been duplicated by many competitors and it is necessary to create differentiation by improving its sensory characteristics. In the first phase by using a focus group they explore the possible sensory variations of the product across the five senses in conjunction with a given marketing concept and next through a statistical experimental design a number of combinations have been tested quantitatively. This is a good example of the feasibility to use multi design method for the new product development based on mixed qualitative and quantitative approaches.

#### **Conjoint analysis**

Moskowitz et al. (2006) showed how experimental design and conjoint analysis can represent a general framework for the sensory professional to become more involved in the early stage of product development at the concept development phase (Figure 1). This approach expands sensory science to more cognitive aspects therefore, sensory professional is required to participate in concept

development and not only to the measurement of the sensory responses. Among the research methods used in NPD, conjoint analysis with its theoretical basis of experimental design of ideas has been recognized as one of the building blocks for product development (Green et al., 2001; Freewer et al., 1997; Krieger et al., 2003). The important aspect of the experimental design is that panellist does not know that the individual idealets come from different products and are mixed together for the first time in combination that could spell out the concept for a totally new product category. The increasing number of paper on conjoint analysis documents this growing interest. This method allows the researcher to understand attitudes using ideas rather than products. It falls into the category of methods that "diagnose futures which drive acceptance" (Moskowitz, 2007) that means to understand what is important in the concept. Conjoint analysis can incorporate tasting sessions (Haddad et al., 1997). This method measures respondents' judgments of the similarities or differences between different product profiles and assessment becomes possible by studying the joint effects of attributes on consumer evaluation (Hair et al., 2005). Different factors can be evaluated thanks to conjoint analysis and they represent other examples of its capacity to test the conjoint effect of sensory characteristics and other market factors like label attributes (Carneiro et al., 2005; Jaeger, 2000) and origin (Poelman et al., 2008; Schnettler et al., 2007; Grunert, 1997). The integration of sensory differences (Haddad et al., 2007) as factors in conjoint analysis may be important to select most advantageous sensory quality and product information for the target consumer group (Helgesen et al., 1998; Enneking et al., 2007). Moskowitz (2007) presents a systematic approach to concept development using experimental design. He presents the concept development approach as the precursor to systematized innovation showing how elements can be matched to generate an entirely new to the world product category combining features of donuts, cookies and chocolate candy. Using this method Research and Development must become part of the group that deals with concept and that gives the orders, it is time that sensory researcher expand their objectives to enter into the very early stage of development. From this review conjoint analysis appears as a method able to be used to integrate the sensory product aspects with the other marketing elements at the early stage of new product development. It finds great use in food product development and only recently there is reluctance because of its high costs (Moskowitz, 2005). The conjoint analysis is able to combine intrinsic factors like taste, with extrinsic factors and best results appear from its integration with qualitative techniques that allow to explore the sensory variations of the product in conjunction with a given market concept in order to put the voice of consumer at the early stage of product development.

### ***Category appraisal***

The operating procedure is based on preference analysis. Different rival products are presented to the respondent to be ranked and sorted on the base of sensory preference or perceptual attributes or on their dissimilarity. Respondent's individual preferences or attributes are visualised with a statistical procedure like factor analysis or multidimensional scaling in a geometrical space. The map, shows intensity of competition between products, summarises how consumers perceive product on each attribute, show relationships between attributes and how well they differentiate between products, indicates areas of the map which are desirable to certain segment of consumers (Van Kleef et al., 2005). This method, is used when the developer wants to discover what drives liking, but does not want to conduct experimental design. It happens when the effort to create the combination of ingredients is deemed to be too costly for the payout. In many instances, it is very time consuming and expensive to create the necessary prototypes dictated by the experimental design. At the same time, however, researchers wants to understand what features of the product from a sensory level, drive overall liking, they wants to discover the patterns, but not to create the combinations. In these situations the researcher might then test a variety of in-market products, which are basically unrelated to each other except for the fact that they are representatives of the same type of product. Category appraisal has been discussed in a number of books and articles (Moskowitz et al., 2006). Moskowitz and Marketo (2000) showed different strategies for selecting test products in category appraisals. The three strategies are random selection of products from the marketplace, selection on the basis of consumer sensory data, and selection on the basis of expert panel data. All three methods produce stable results for category appraisals. The stability of the results increases very quickly and suggesting that the researcher does not have to work with a particularly large number of products in a category appraisal to understand the sensory-liking dynamics. Other interesting application of category appraisal comes from Moskowitz (2002) that analyses data from a study on soups tested 'unbranded', showing the approach by which one can understand what sensory attributes co-vary with or 'drive' image attributes. Category appraisals reveal whether or not specific products are perceived to be appropriate for different end uses and whether there exist opportunities for new products that have a desired image profile. Consumers evaluate the product on the different set of attributes, generating the 'signature' of the product. The approach, combining category appraisal for data collection and response-analysis to understand drivers, provides the researcher with a conceptual framework in which to extend the understanding of product attributes. As

reported in the study of Jaeger (2000), Moskowitz and Jacobs (1988) support category appraisal method for identifying the sensory attributes which cause acceptance. Important characteristics selected by the sensory scientist are identified from consumer ratings of intensity and liking of individual and category sensory attributes. Although, this approach may appeal to many in R and D it may not capture the primary consumer requirements and Earthy, MacFie and Hedderley (1997) raised concerns that there are likely to be biases introduced if attribute type questions are asked simultaneously with overall preference. Depending on the magnitude of such effects key sensory attributes may be wrong. Category appraisal is a product-driven method and provides a restricted view on consumer needs, therefore it drives only to incremental new products and it can be used for technical product development.

### ***Kelly repertory grid***

The Repertory Grid Method (RGM) is a qualitative method, a semi-structured technique which is often applied to consumer and market research. The RGM is part of George Kelly's (1955) major work "The Psychology of Personal Constructs", a psychological theory that aimed to explain the difference among persons in their attitudes, behaviours and views towards events in the world. Therefore, the RGM has been used as method for investigating people's view of their inter-personal world. It identifies peoples' perceptions by exploring personal constructs. According to Kelly's theory, people make use of their own criteria to understand the world by evaluating, analyzing and developing a personal repertoire of constructs (personal interpretations) of experienced events. Kelly (1955) defines a construct as a "way in which two things are alike and, in the same way, different from a third". Repertory grid method is a personal interview technique in which constructs are shown that consumers use to understand a product category. Participants are repeatedly confronted with a selection presented in a group of three and have to think in what way two of them are similar and different from the third one. Once identified the way to discriminate between products, the attributes are written down on a grid sheet. A repertory grid is a matrix representation of products and attributes. Each product can be scored against each attribute to find out its importance. This method was used to elicit constructs from 23 children between 8 and 11 years of age relating to their perceptions of eight common vegetables (Baxter et al., 1998). These personal constructs were scored, in relation to each of the vegetables. It was found to be suitable for use with child assessors aged 8 years and above. Results showed that the children sorted these vegetables according to sensory properties, situational usages and perceived necessitate for cooking. Textural properties were mainly

associated with aversion to certain vegetable preparations. Hersleth et al. (2005) used this technique to investigate consumers' perception of bread and the appropriateness of use of seven type of norwegian bread, different in recipe, type and shape and consumers elicited construct. Monteleone and his colleagues (1997) used RGM to obtain an understanding of the characteristics used by U.K. consumers in discriminating amongst different common starchy food dishes, including potatoes, rice and pasta. Twenty-nine subjects generated a large number of attributes, relating to perceived nutrition, health, physiological effect, sensory, and use attributes of these products. This method was combined with quantitative information describing common and individual characteristics of particular dishes. Results indicate that starchy foods are in general seen as "filling", but specific products are clearly discriminated along two dimensions, predominantly relating to nutritional value and sensory/functional characteristics. Russel and Cox (2004) used RGM to assess 14 meat products of three age groups of Australian consumers. Differences between age groups were observed: middle-aged and young consumers perceived white meats and fish as "healthy" and not red meats, which resulted in contrast to the older group who perceived red meats as "healthy". Middle-aged and older consumers shared perceptions of lamb and pork chops, roasted chicken and comminuted or processed products; perceiving these more positively than the young group. Medeiros de Melo and his colleagues (2009) in their study to determine the sensory properties and acceptability of lab developed prototypes of conventional, diabetic, and diabetic/reduced calorie milk chocolates used Kelly's Repertory Grid Method to generate attribute using same lab developed prototypes and other commercial nondiabetic and diabetic chocolates. Results from this study have shown that consumers prefer the sensory characteristics of conventional chocolate to their alternative counterparts when tasted without product information such as health claims. There are several examples in the sensory marketing literature (Mc Ewan and Thomson, 1989; Mucci and Hough, 2004) on the used of this technique, but rarely has it been used for new product development.

### ***Laddering***

Laddering is a practical instrument for investigating the means-end chain theory for the subjective connection of product attributes, consequences of product use and values. It is a semi-qualitative technique with data collection in two parts: first some relevant attributes have to be found by direct questioning, triads or sorting of products into meaningful piles and then consumers are asked for their preferences with regards to these attributes with the repeated questions until he is unable to answer. In this way he is pushed up the means end

ladder. Results are coded and similar answers are grouped in the same category. An implication matrix is constructed with on the row and on the column the categories resulted from the previous process. From the matrix is constructing the hierarchical value map that summarizes the main associations between cognitive categories in the form of network (Grunert et al., 1996). Krystallis (2007) defines means-end chains as hierarchical cognitive structures relationships between product attributes and product consequences. The product attributes can be concrete (sweet) or abstract (healthy). The product consequences fall along a continuum as follows: functional, psychological, instrumental values or terminal values. To develop a superior new product, consumer research needs to identify consumers' product attribute perceptions, use benefits and personal value that provide the basis for choosing products. Means-end chain analysis is useful to understand the crucial factors that affect consumer perceptions, preferences and choices (Kristallis, 2007). Flight et al. (2003) showed how perceptions of attributes, consequences and values attributable to red meat were elicited in middle-aged and young elderly consumers in one-on-one interviews. Quantitative analysis revealed pictorial representations of the motivations for consuming red meat specific to the two consumer segments. For example, elderly females perceived lean red meat to have the benefit of aiding weight control which in turn provided a healthy life with the outcome enjoying life. These ladders have practical application in the construction of personally relevant promotional messages. Roininen et al. (2005) in their study to establish the personal values, meanings and specific benefits consumers relate to local food products showed the advantages of laddering compared to word association. Also Ares et al. (2008) compare these two techniques to understand consumer's perception of conventional and functional yogurt. Laddering interviews provided important information on the relationship between perceived attributes and the reasons for choices whereas word association provides an effective and quick method for gathering information. Word association was more sensitive than hard laddering in determining differences between groups of consumers with different attitudes towards health and nutrition and therefore it might be an interesting and useful qualitative technique for product development. Cavicchi et al. (2009) explain the importance of the laddering with an example of how semi-skimmed yoghurt that contains fewer fats and therefore, fewer calories than whole yoghurt can be linked in consumers mind to the consequence of less cholesterol, and beyond that to increased longevity as a value. Poor packaging likely increases the perception of tasteless yoghurt therefore, consumer product requirements must be defined such that all of them can be incorporated into product development. Quantification of the strengths of constructs and linkages facilitates identification of new hooks or opportunities for potential

products even if it is not very used to integrate the sensory analysis in other aspects of consumer research for new product development. This technique applies to the creation of new products, as well as repositioning or retargeting familiar food products that are close to the end of their life cycle. Laddering as explained by Van Kleef et al. (2005) are appropriate for incremental new products. It is more appropriate for marketing than for R&D purposes as it reveals more abstract product use benefits and consumer values and it is too abstract and allows too many degrees of freedom for explicit translation into tangible product design.

### ***Free elicitation***

This method for picking from an attribute list which ask subjects to come up with self relevant attribute, or to select them from an attribute list generated from a previous qualitative study. It can provide further information about how preferences are formed but it is scarcely used to integrate sensory analysis with consumer research in new product development.

### **THE INCLUSION OF SENSORY ASPECTS IN THE HOUSE OF QUALITY**

One method to organize the product development process is the quality function deployment (QFD) model. It is a method to encourage product developer team members to communicate more effectively with each other. The existing framework for linking physical science to the economic approach (Steenkamp and Van Trijp, 1996) can improve the physical food product on the basis of consumer demands by taking consumers' quality judgements as a point of departure and relating them to the characteristics of the physical product. The QFD tool is designed to help planners focus on the characteristics of a product or service and thereby increases customer satisfaction by making sure that customer demands are brought into the product development process. The QFD approach emphasises the voice of the consumer as the preliminary aim of product development. The approach also is based on identifying the relationship between the sensory aspects of the product, the technical relations, and their combination, such that it relates all of the aspects to the voice of the consumer in the product development process. Thus the probability of innovation success increases.

The quality food deployment method consists in the construction of one or more matrices. The first matrix is the House of Quality also known as the Product Planning Matrix, which translates customer needs into measurable technical attributes with the goal of defining the objective of the product development (Bech et al, 1997). The House of Quality consists of several phases (Cavicchi et

al., 2009). The first is the voice of the customer, which indicates product quality requirements. The sources of information include in-depth interviews, focus groups, and other qualitative techniques. This step is very sensitive, because the subsequent steps are based on these results. After establishing the customer requirements, this information defines the position of the company compared with competitors and in relation to customer perceptions. This process happens in the so-called strategic planning room. By considering the goals of the company, it is possible to identify market opportunities through a comparison of future strategy and customer satisfaction. At this stage, the requirements are listed. Because of the correlation among product characteristics, it is important to specify their degree of interdependence in the technical correlation room. This matrix identifies the situations in which the technical requirements support or impede one another in the product design stage (Chakraborty and Dey, 2007).

Changing one product characteristic affects the other attributes. Through marketing research, it is possible to understand the presence of trade-offs and synergies among sensory and non-sensory attributes, as well as interactions, as means for implementing a marketing strategy. The complex task is to fulfil the aims of the innovation through a checkpoint, namely, the technical competitive assessment of the product's characteristics and the organisational difficulty related with the innovation. These results then are compared with the customer's competitive assessment, which indicates the advantages of a competitive product for fulfilling the customer's needs. This comparison occurs in the relationship room. The last part of the House of Quality is the technical priorities room, in which the technical competitive assessment is compared with the customer competitive assessment to determine the evaluation of the products from both the company's and the customer's point of view. It identifies weaknesses in the other steps. This analysis highlights the target value that represents the performance that the company must accomplish to achieve customer satisfaction. The application of the House of Quality model to food product development was proposed by Bech et al. (1994).

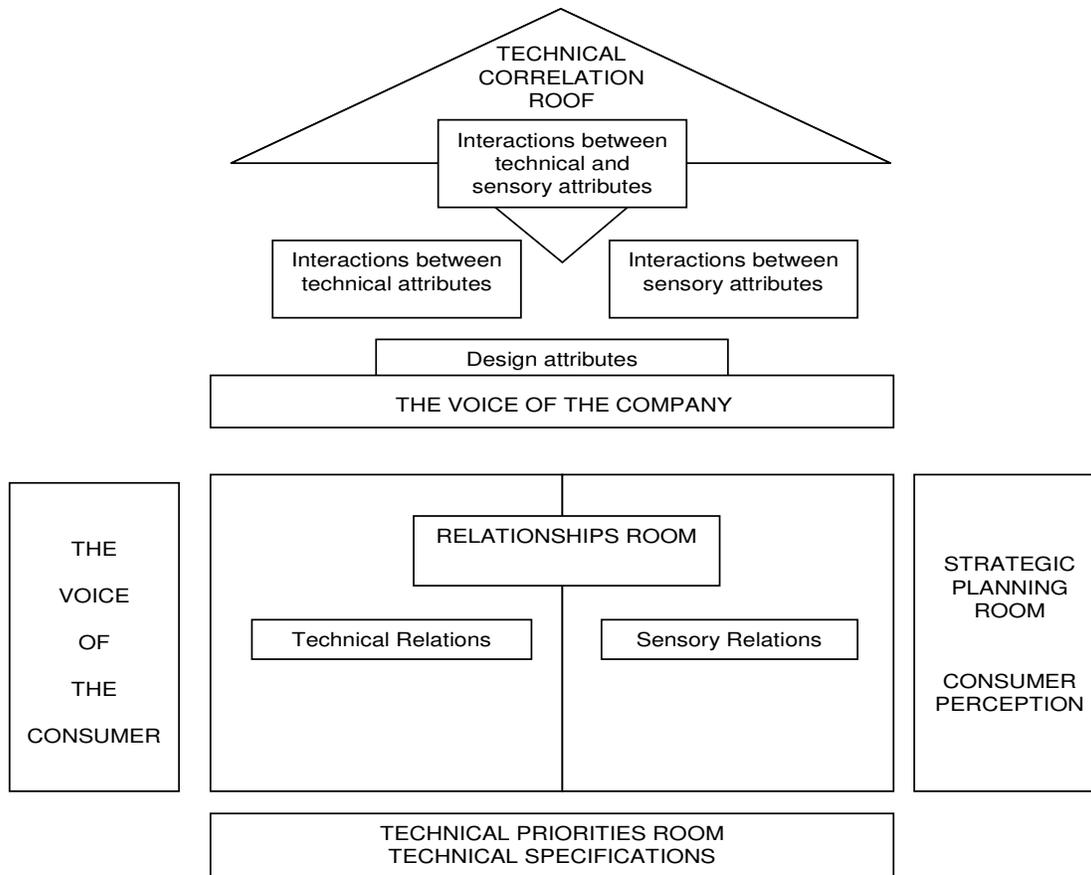
The relationships among sensory attributes, technical attributes, and consumer requirements are exhaustive. The modified model for food product development aims to translate consumers' requirements into sensory attributes, measurable by descriptive sensory analysis, to reflect specific food sensory properties. Figure 2 shows the main part of the model. Consumer analysis attempts to understand the importance of the product attributes evaluated by consumers, their knowledge, and behaviour. The design attributes include technical and sensory relations across the quality standards. Their scores become the technical and sensory specifications, with calculations of the improvements. Consumer perceptions derive from their competitive assessments,

which indicate any advantage for a particular product because of its ability to fulfil the customer's needs. From the review come up several examples of the application of House of Quality model to translate consumer needs for sensory food quality into sensory attributes. Viaene and Januszewska (1999) apply the QFD to chocolate, demonstrate that consumers' judgement is based on intrinsic quality attributes and even if promotion and packaging can enhance the expectations, the main attributes are of sensory nature. Two articles also review QFD applications in the food innovation process (Benner et al., 2003). Tomato ketchup, peas, chocolate cake mix, and sugar-free butter cookies, among others, have been analysed using this technique. Several articles incorporated the "Modified the house of quality" to include sensory aspect: the HOWs are divided into a technical and sensory part (Bech et al., 1994; Bech et al. 1997; Bech et al. 1997; Viaene and Januszewska, 1999).

QFD is only suitable for product improvement at this stage and not for the development of truly innovative products. Problem that arises is that it is not possible to give precise target value for the food product requirements compared to other industries: the quality and taste of ingredients differs even during the day and even if it is standardised and the same ingredients can show variations. Among the weaknesses of QFD method, underlined in the work of Benner et al., (2003) there are two of major interests for this contribution:

- i) Sensory requirements are still difficult to measure. It is difficult to control them because they are dependent of multiple variables related to product, production, process, consumer or the surroundings.
- ii) Sensory analysis usually consists of about 20 sensory dimensions per product. This is a large number for a consumer to evaluate (Benner et al 2003).

The literature about application of QFD in the food industry is limited. In spite of the claimed benefits of QFD for the development of food products, it still needs a lot of understanding before the method can be applied. Examples of its application for the development of food products are still limited to few cases. A positive feature of QFD method is that the matrices can provide a link between the quality characteristics as demanded by the consumer and the actors in the production chain. Market driven approaches to developing food products in accordance with consumer demands have relied on frameworks like House of Quality. The key quality attributes reflecting consumer demands and their relative importance are usually obtained using qualitative market research techniques like focus groups and structured in-depth interviews. Grunert et al. (1996) recommend the focus group interview method, and this has also been the favoured method in food related applications of the House of Quality (for example, Bech et al., 1997; Bech, et al., 1997). Studies of quality perception for food products



**Figure 2.** Modified House of Quality for food product development: Interaction among sensory and technical characteristics (Viaene and Januszewska, 1999).

(Steenkamp, 1989; Steenkamp and van Trijp, 1989) in line with van Trijp and Schifferstein (1995) that support the importance of closer integration between marketing and R and D sensory methodology, have relied on group interviews, in-depth interviews and discussions with experts for the selection of key intrinsic quality cues (Jaeger et al., 2000).

## MANAGERIAL IMPLICATIONS

Product performance alone is not the single determinant of consumer choice. For example, in the market of low or no fat products or products nutritionally enhanced with omega-3 fatty acids, the products may not taste as good as a conventional product, yet be purchased for other nutritional benefits, not just price or flavor (Civil and Heylmun, 2003). Therefore, sensory testing must not be limited only to laboratory and sensory methods alone but it must include attitude and usage questions, demographic segmentation price and all the other aspects typical of consumer research and market issues. Problem is that most product developers in the food and consumer products industry have backgrounds in the physical

sciences or in product technology areas (Cardello, 2004). Rarely do they have backgrounds in psychology, marketing, economics or other disciplines associated with consumer science and therefore, the use of advanced techniques of product testing and sensory analysis is still limited. The familiarity with interdisciplinary methods will strictly depend on the improving of communication between consumer researchers and natural scientists or product developers also through a change in the company's organizational culture.

## PERSPECTIVES

The sensory and product testing researchers have been often called on to participate in the development of new products but they only quantify consumer reactions to prototypes developed in the pilot plant. It is high time to bring concept research into the product development. Nowadays, R&D in general and sensory research in particular have to expand their horizons into the very early stage of development (Moskowitz, 2007). In order to develop successful new products, companies should gain a deep understanding of consumer. Consumer research

to develop new product can be carried out during the different stages of new product development. In contrast to the attention paid to the techniques such as posterior product testing, analysis of strengths and weaknesses of consumer research methods, only little attention has been devoted to the opportunity identification stage of the new product development process even if it is increasingly recognised that successful new product depends on the quality of this first stage. One possible reason for the lack of success in integrated sensory-oriented research into the design of the product is the absence of research tools for research driven innovation.

The tool that sensory scientists use comes when the product is completed and can work in the final part of product development process.

## CONCLUSION

Sensory analysis has to be combined with modern market research methods in order to develop integrated approaches that are able to evaluate extrinsic as well as intrinsic product attributes and possible interactions between them (Enneking et al., 2007). Understanding the relative importance of each product attributes influencing food choice at the point of sale is important to the success of new product. Results from these review showed that some of these techniques may not have attained extensive adoption by product developers. The problem with certain consumer techniques is that the conceptual bases, theoretical constructs, and descriptive terminology associated with them are distant to product developers and the subjective and qualitative nature of certain of these techniques place them in conflict with the more quantitative and can create a situation in which data collection and analysis are subject to the idiosyncrasies of the researcher (Cardello, 2005). Sensory information are strategic for defining how consumers will perceive a product in relation to position the product and how the product competes with other products in that category. It is important to develop this information in the early stage of product development in a way to focus the efforts. For this purpose, an effort needs to be made to implement new practitioner's tool in NPD and in many case to change company's organisational culture. It is hoped and intended by this review that food scientists will be aided by the analysis proposed here in their future study on the integration of sensory research with other elements of consumer choice in NPD.

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