

ON THE APPLICATION OF CONSUMER EVALUATION IN DEVELOPING NEW FOOD PRODUCTS

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***Abstract:** In the article are discussed the problems of consumer evaluation of new food products throughout all the stages of their development. It is marked, that the key role of consumers in the identification and evaluation of the quality indicators greatly depends on the demands of the market and management. It has been shown that the success of a new product on the market depends rather on comprehensive fulfillment of customer requirements. Innovative ideas about new product of manufacturers, work under uncertainty and high risk should be based on the use of methodology of consumer evaluation at the main stages of new product development and construction.*

The great attention of this article focuses on the comparative analysis of assessments by the results which have done untrained and trained testers and experts opinions.

The experiment showed a great convergence of scores which are given by trained testers and experts. It concerns for the flavor and the consistency of the product. Practically almost full convergence was the result for two descriptions: the product appearance and the color of its surface. Untrained testers' scores commonly differed from two other groups. It shows that while making new projects of creating a new product trained testers representing the target group of consumers should be involved in sensory evaluation tests when a new food product is developed. This will allow to create products perfectly meeting the consumers wishes more regarding, particularly, the organoleptic characteristics.

***Keywords:** Consumer evaluation, product design, food products, organoleptic testing, the consumers demands, sensory laboratory testing, sensory panel, focus group, moderator, sensory sensitivity, the cluster of Flavor composition, interval scale, the cluster of product appearance, the cluster of the consistency of the product.*

1. INTRODUCTION

The development of various food products is related to the consumer evaluation, which is as important as the market position, as a distribution level and total sales of an enterprise, the recognition of its brand, etc.

A food enterprise must constantly focus on customer needs, study their requirements and wishes to know the customers before, during and after purchase,

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in order to know their hidden preferences and needs. These preferences can be complex although they are always linked with physiological, psychological and socio-economic aspects. This is why a new food product developer must know why consumers buy products, how they perceive them, and whether marketing efforts could change or encourage customer's purchasing decision.

Consumer's desire to buy a particular product depends on many conditions, among which the most important are the price and quality. The price of goods is determined by the maximum amount that a buyer is willing to pay for the product meeting answering the requirements and the concepts of quality. Successful market promotion of a product depends on its price, which includes product cost, the cost of transportation, storage and sale, as well as the profit share of each participant of supply chain. Imposed restriction of prices considers that in conditions of free market a consumer do not choose expensive products and seeks to find affordable goods corresponding to his ideas about quality. Influenced by personal experience, recommendations and advertisement, customer quality expectations may change after heats the food product and perceives its real quality. Dissatisfaction can arise due to the mismatch between the perceived and expected quality. This primarily refers to the organoleptic characteristics of food products, significantly affecting the overall quality evaluation.

Customer satisfaction is a complex concept, depending on pleasure or disappointment resulting from comparing the expectations and real perception. The user can re-buy the same product, but if once again he is not satisfied, then the perceived mismatch will provoke him to buy the same product from another manufacturer afterwards. (Van Kleef, Van Trijp, & Luning 2005; Westad, Hersleth, Lea 2004)

The most important element of food business activities is the creation of target audience for various groups of products. The expansion of target audience is one of the strategic objectives of food manufacturers. An adequate offer of high-quality products to satisfy target consumer requirements is an essential condition for success.

As noted by many authors (Tikhomirov 2016, Matison 2016), the quality of food is largely depends on its organoleptic characteristics. The use of sensory analysis methods to evaluate the designed food quality is one of the components of successful sales promotion today, when the food market is extremely saturated, and new, non-standard and specific products and ingredients improving the organoleptic parameters constantly appear.

The evaluation of product sensory quality by the enterprise taste panel is necessary but not sufficient for the successful promotion of product on the market. Research and Development department always needs to collect data from consumers and compare them with the expert evaluation.

Sensory and consumer research in food product design can be carried out either in focus groups or as a laboratory sensory test. A focus group usually consists of 8-12 tasters that sit at the table in a clear area and discuss the qualitative characteristics of the product. A moderator administers the group and provides that the discussions focus on the organoleptic properties of the test sample. In the focus group interaction effects are often observed, when the statement of one of the participants provokes debate. The moderator's task is to define the ratio between perception and preference and to adopt an ascending scale order for indicators characterizing the product appeal.

Unlike focus groups used in marketing, in the consumer sensory test the quality indicators are studied. Most of them are organoleptic, i.e. associate with the human senses (Tuorila, H., & Cardello, A.V. (2002), Liem, D.G., Mars, M., & de Graaf, C. (2004)).

Conducting consumer research by sensory testing provides certain advantages in reliability and accuracy of the results, but requires additional costs for equipment and organizational charges. Although in some cases free and open debates about consumer preferences and perception are considered as a positive factor, but most often, despite the moderator's efforts, more active participants impose their views on the entire group and the statements of some shy consumers are not always taken into account. The sensory testing eliminates this disadvantage by separate sensory analysis facilities, training and testing of assessors, appropriate scale selection (Kreutzmann, S., Thybo, A.K., & Bredie, W.L.P. (2006), O'Sullivan M.G., Byrne D.V., Martens H., Mattens M. (2002), Westad, F., Hersleth, M., & Lea, P. (2004), etc.). Besides, this method is as close as possible to the working conditions of enterprise corporate experts panel.

The studies of Lee C.M. et al., 2004 and Husson F.S. et al., 2001, showed the importance of methodology of sensory profiles in the evaluation of food's organoleptic properties.

In consumer sensory test, as well as in a focus group testing, the key role in organizing test procedures belongs to the moderator, who:

- selects testers;
- develops training programs for testers;
- develops consumer testing programs including schedules;
- carries out consumer testing;
- interprets the results and prepares a report on performed tests.

The main difficulties encountered by moderator lay in interpreting of the discussion results and identifying customer requirements with preference ranking.

This is because even the pre-selection of testers based on the criterion of regular consumption of tested product, does not guarantee the full compliance of the results which obtained from the focus groups, with the data from the entire customer segment.

In addition, perception of product's characteristics and decision to purchase is greatly affected by gender, regional, psycho physiological and other factors (Kahkonen, P., & Tuorila, H. (1999), Koster, E.P. (2003), Yeomans, M.R., Mobini, S., Elliman, T.D., Walker, H.C., & Stevenson, R.J. (2006), Zellner, D.A., Strickhouser, D., & Tornow, C.E. (2001)). We can observe increasing reproducibility and correlation with the characteristics of food products among pre-trained consumers who have passed the sensory sensitivity test (Duineveld, C.A.A., Arents, P., & King, B.M. (2000), Koster, E.P., Couronne, T., Leon, F., Levy, V., & Marcelino, A.S. (2003), Tenenhaus, M., Pages, J., Ambroisine, L. & Guinot, C. (2005)).

The undertaken consumer research consists of identify the differences and/or matches in the evaluation of confectionery products due to organoleptic characteristics for three groups of testers:

- untrained testers, elected for regularly usage of the studied confectionery products;
- trained testers selected for their sensory feelings;
- experts in confectionery.

2. METHODS AND MATERIALS

Our consumer research and testing took place in a food sensory laboratory equipped with facilities and supplies meeting the requirements of the international standard ISO 8589. Twelve individual testing booths, each was supplied with a special food pass-through device, were installed in the testing room. The lighting in the booths was uniform and shadow free, allowing to properly assess the appearance and color of samples and packaging. The desktop surface was large enough to accommodate samples and dishes and to enable the completion of questionnaires. The laboratory was kept free from odors and external noise, the color of the walls and booths was neutral. Thus, extraneous factors able to influence testers were totally excluded. The preparation area was separate from testing room. All samples were coded by a three-digit number.

As noted above, the studies involved three groups of testers. The first two groups were selected from the students aged 19 to 21, of both genders. The only requirement was to eat chocolates at least twice a week. We selected 40 testers, 12 of them formed the first group of untrained testers. The study involved 10 people from this group and 2 students were present at tests for replacement when necessary.

The second group of testers were selected from 28 trained people. They all were tested for:

- taste sensitivity;
- olfactory sensitivity;
- color sensitivity.

To test individual taste sensitivity, several requirements of International standard ISO 3972 were applied. At the first stage, the violation of taste sensitivity (ageusia) was excluded. In accordance with the standard, four taste reference substances in specified concentration were prepared in aqueous solution and passed to each participant's booth. The samples included 7 variants: sweet ($n = 2$), bitter ($n = 2$), salty, sour and fresh water. Testers tried every solution, then rinsed their mouths with water and ticked a box in a worksheet, which is shown in Table 1.

Table 1
The evaluation of taste perception

<i>Name of tester</i>					
<i>Date, time</i>					
<i>Sample</i>	<i>No answer</i>	<i>Sweet</i>	<i>Bitter</i>	<i>Salty</i>	<i>Sour</i>
132			×		
284		×			
186					×
351	×				
121		×			
258				×	
312	×				

Tick a box that corresponds to your perception of sample taste

In case of wrong identification during re-testing participants left the test.

At the second stage, the participants were tested for violations of the olfactory sensitivity (anosmia). The international standard ISO 5496 requirements were fulfilled. The method of odor in flasks assessment was applied. Only food flavorings having stable composition were used. Each tester received a series of five flasks to identify the odor of each sample. A tester opened each of the flasks, smelt the sample and identified his/her sensation using the worksheet, shown in Table 2. Then he/she closed the flask and passed to the next sample. Participants were allowed to reassess samples. If the tester once again could not determine the category of smell, he was excluded from the panel.

Table 2
The evaluation of odor perception

<i>Name</i>					
<i>Date, time</i>					
<i>Sample #</i>	<i>Did you feel the smell?</i>		<i>Did you recognize the smell?</i>		<i>Smell</i>
	<i>Yes</i>	<i>No</i>	<i>Yes</i>	<i>No</i>	
228	×		×		Citrus fruit
314	×		×		Vanilla
187	×		×		Peppermint
253	×		×		Jasmine
385	×		×		Pine needles

Tick a box

At the third and final stage of testing, the color sensitivity of testers was detected. Each participant received a block of samples representing solution of red, yellow and green colors in various concentrations and thus of different color intensity. The task was to place samples in order of increasing color intensity, Table 3.

Table 3
The evaluation of color perception

<i>Name</i>				
<i>Date, time</i>				
		<i>Samples</i>		
		<i>Red</i>	<i>Green</i>	<i>Yellow</i>
1 minimum		162	318	168
2		384	280	314
3		251	323	235
4		143	273	112
5 maximum		328	314	292

Rank samples in order of increasing color intensity writing 3-digit codes in corresponding boxes

Sample solutions were presented in random order. If the tester made more than three mistakes during initial testing and re-testing, he/she was excluded from the panel. The sensory sensitivity test allowed to select 12 testers, for whom a 6-hours initial was organized.

The training program included:

- familiarizing with testing procedure and objectives, - to establish differences in sensory evaluation scores given by trained and untrained testers;

- learning about confectionery tested;
- detailed analysis of descriptors proposed to evaluate food products;
- description of test stages, including preparation and coding samples; evaluation of each descriptor using interval scale, filling the worksheets with results of evaluation;
- familiarization with methods of test results statistical treatment allowing to increase their reliability and accuracy.

In this study, an important part was played by moderator, who was charged with the preparation, organization of test and the presentation of its results. The moderator selected participants, held interviews with them, being guided by the rules of food products sensory evaluation for the study undertaken. The criteria for testers selection were the following:

- selected testers should be regular consumers of tested products;
- testing panel should simulate a group of people representing the market segment for tested products;
- testing must involve young people of both genders aged 18 to 21.

The moderator was also tasked with testing and training the second group of testers as well as selecting experts in confectionery products.

As a specialist in food organoleptic testing, moderator worked at the identification of descriptors together with representatives of the enterprise that had provided the samples of confectionery production for testing.

Two kinds of confectionery products were tested in the experiment:

- "Prune with almonds in chocolate";
- "Dried apricots with almonds in chocolate".

Three clusters of descriptors were chosen to describe most comprehensively the organoleptic profile of products:

- product and packaging appearance;
- flavoring composition;
- product consistency.

In consultation with the expert group moderator identified the following descriptors.

The cluster "Product and packaging appearance" included six descriptions:

- product appearance;
- color of surface;

- surface gloss;
- packaging appearance;
- colorfulness of packaging;
- attractiveness of packaging.

The cluster “Flavor composition” also included six descriptions:

- taste of product;
- sweetness;
- freshness of fruity taste;
- intensity of almond bitter taste ;
- aftertaste;
- aroma of chocolate.

The cluster “Consistency of the product” included three descriptions:

- hardness of chocolate glaze;
- hardness of almond;
- stickiness of chocolate.

To evaluate the testing results with the use of identified descriptors a five-point interval scale was chosen, Figure 1. In the sensory tests, the selection of scale plays an important role (Villanueva et al., 2005)

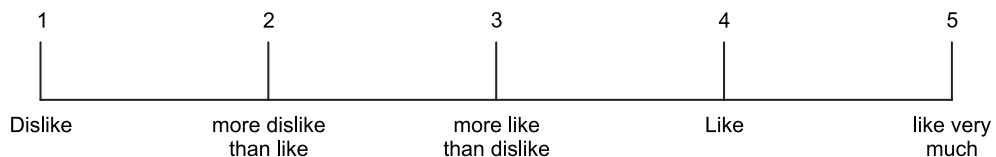


Figure 1: Five-point interval scale

This scale allows to adequately evaluate the results of the tests, completely covering the entire range of possible responses of selected testers. Using the interval scale and obtaining the evaluation scores made it possible to perform a comparative analysis using statistical methods.

Three paired samples were considered in the processing of testing results:

- I - II, I - a group of 10 untrained testers and II - group of 10 selected and trained testers.

- I - III, III - a group of 6 experts in confectionery.
- II - III.

Each sample included different groups, so they were independent.

The following hypotheses were developed during comparative evaluations:

- The null hypothesis about the identity of average scores in paired samples under consideration,
- An alternative hypothesis about the difference between average scores in paired samples under consideration.

If the observed value of Student's criterion for the selected significance level of 0.05 for two-tailed test was less than the theoretical value, the null hypothesis was accepted and the conclusion was made about the identity of test results in groups (I-II, I-III, II-III) for the descriptors under consideration. If the observed value of the Student's criterion was more than theoretical, we accepted the alternative hypothesis that the results are not considered identical and the average scores differ significantly.

3. DISCUSSION AND RESULTS

The results of the study undertaken are given in Table 4. The analysis shows that the complete convergence in responses in all three test groups was observed only for two descriptors: product appearance and the color of its surface. By applying Student's test, we revealed deviations in responses of different testers groups for all other descriptors.

In the cluster "Product and packaging appearance" the scores coincidence was observed in "surface gloss" between trained testers and experts, evaluations of other pairs did not match. "Appearance, colorfulness and attractiveness of packaging" were similarly evaluated by groups of untrained and trained testers, while experts gave higher scores to the same tested products.

In the most significant cluster "Flavor composition" the tendency of scores was coinciding and revealed for the groups trained testers - experts. Untrained testers gave higher scores than the other two groups. An exception was the descriptor "freshness of fruity taste" for which all groups gave the same assessment to the product "dried apricots with almonds in chocolate."

Practically almost the same tendency continues for the cluster "consistency of the product," in which the product "Prunes with almonds in chocolate" received the same scores from trained testers and experts, and only the chocolate stickiness in "Dried apricots with almonds in chocolate" had different assessments.

Table 4
The evaluation of confectionery products descriptors

Cluster	Descriptor	Prunes with almonds in chocolate			Dried apricots with almonds in chocolate		
		I-II	I-III	II-III	I-II	I-III	II-III
Product and packaging appearance	Product appearance	+	+	+	+	+	+
	Color of surface	+	+	+	+	+	+
	Surface gloss	-	-	+	-	-	+
	Packaging appearance	+	-	-	+	-	-
	Colorfulness of packaging	+	-	-	+	-	-
	Attractiveness of packaging	+	-	-	+	-	-
Flavor composition	Taste	-	+	+	-	-	-
	Sweetness	-	-	+	-	-	+
	Freshness of fruity taste	-	-	+	+	+	+
	Intensity of bitter taste of almond	-	-	+	-	-	+
	Aftertaste	-	-	+	-	-	+
	Aroma of chocolate	-	-	+	-	-	+
Product consistency	Product hardness	-	-	+	-	-	+
	Almond hardness	-	-	+	-	-	+
	Stickiness of chocolate	-	-	+	-	-	-

«+» - convergence in assessment

«-» - discordance in assessment

4. CONCLUSION

Thus, this study has confirmed the need to involve trained testers in evaluating quality indicators and above all the sensory characteristics of food products being developed and recycled. Based on these results, a developer can create a new product formulation, design and shape of product and packing matching the wishes of consumers and their needs.

It should be noted that trained testers play a special role in food product design. Properly prepared the testing program, by the moderator, allows to determine the overall direction of product development, left them to identify correlations between the sensory descriptors and technical characteristics of the product and thereby ensure its market success.

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