(RESEARCH ARTICLE)

Improving the characteristics of a sensory response during jury training

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Abstract

Sensory analysis is a scientific discipline that involves analyzing products in a controlled, standardized way. It requires a panel of tasters to produce an average of the tasting results. The aim of this study is, on the one hand, to list the difficulties associated with panel performance and, on the other, to provide input for the development of panelist training. The jury was made up of men and women over the age of 18. They were engineering and doctoral students respectively from the School of Agricultural Sciences and the Polytechnic Doctoral School. The scoring sheet was used to specify preferences in terms of food tastes, flavors, textures, aspects and colors. Next, respondents were asked to indicate any dietary constraints or allergies they might have, and their level of interest in the project. The improvement in the jury's performance was most pronounced on repeatability. The results show that 24 simple descriptors were used, as the jury had drawn up this list and demonstrated the ability to evaluate them. In addition, 50% of tasters had normal sensory acuity. Evaluation of the panel's discrimination performance revealed that 95.11% to 99.51% were able to differentiate between the concentrations of the products presented to them.

Finally, the different stages studied are consecutive and require personal application to better judge the target product.

Keywords: Sensory analysis; Training; Sensory acuity; Jury

1. Introduction

According to the French standard NF ISO 5492, sensory analysis is defined as "the examination of the organoleptic properties of a product by the sense organs".

Sensory analysis is mainly used by the agri-food industry, but also by manufacturers in the pharmaceutical, cosmetics, automotive, construction and energy sectors... It is a very important scientific approach, even essential, as its various objectives (product design, quality approach, positioning a product in relation to the competition...) help to ensure reliability, quality and, above all, to maintain the product on the market [1]. In a sensory analysis test, panelists (or jury) taste or test different products and evaluate them using one or more descriptors (product characteristics) one or more times (repetitions). The idea is to use the human being as a measuring instrument, drawing on his or her olfactory, gustatory, visual, auditory and tactile capacities to characterize and evaluate products. This involves mobilizing all the senses when tasting food.

Moreover, the biological phenomena involved in sensory perception are well known, and can be broken down into three stages: stimulation by the relevant sensory receptors, translation of the chemical message into a nerve message, and

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interpretation of the nerve message by the brain, which uses its stored experience to convert sensation into perception [2].

This evaluation involves a number of techniques for measuring human responses. In practice, it attempts to isolate the sensory properties of the product being evaluated, and provides important and useful information about the sensory characteristics of the product [2].

However, the ratings given by the jury during a sensory analysis test are usually subject to various biases. According to Meilgaard and al. [3], these errors can be of psychological origin, i.e., due to the representation of the product and the decision on the appropriate response. They may also be of physiological origin, due to the panelist's ability to reproduce the score chosen on a given scale. Similarly, one of the difficulties encountered in conducting a sensory analysis test is that the same subject may not assign the same score to the same stimulus presented several times. These different biases describe both inter-individual and intra-individual differences.

However, solutions proposed by Peltier [1] in his work entitled: "L'analyse statistique du profil sensoriel revisitée par une approche de données" (Statistical analysis of sensory profile revisited by a database approach) have made it possible to make up for certain biases during the statistical processing of data from a sensory evaluation test. Nevertheless, few proposals have been put forward for resolving these biases during training.

So how can we identify the various characteristics that can influence human judgment of a product?

In other words, at what level of jury training is it best to agree in order to give a good rating to the target product?

In this work, we will first list the difficulties in achieving panel performance. Then, we will make some contributions to the development of a more objective panelist training program.

2. Material and methods

2.1. Materials

2.1.1. Jury

The jury was made up of individuals sectioned during a survey carried out at the Institut National Polytechnique Felix Houphouët Boigny (INP-HB) in Yamoussoukro (Côte d'Ivoire). They were made up of men and women over the age of 18. They were engineering and doctoral students respectively from the Ecole Supérieure of Agronomy (ESA) and the Polytechnic Doctoral School (EDP) of INP-HB.

2.1.2. Products used for training

Products commonly used for elementary flavor training were listed (Table 1) following the method of Verdier [4]. A list of 24 common products was taken from the trade in Yamoussoukro (Côte d'Ivoire). These products were prepared and presented to the jury at each stage of training.

Table 1 Common products used for testing [4]

	Sweet	SSucrose
	Salty	Cooking salt
	Pungent	Ginger
	Sour	Vinegar
Taste	Bitter	Bitter eggplant powder
	Acid	Lemon juice
	Umami	Maggi cube
	Astringent	Cashew apple juice
	Rafreshing	Mint juice

Aroma	Fruity	Passion fruit
	Floral	Flower
	Herbaceous	Romain aroma sheet
	Nutty	Nutmeg
	Spicy	Ginger juice
	Lemon	Lemon juice
	Mushroom	Yeast
	Mint	Mint juice
Appearance	Smooth	Dry seed
	Rough	Long pepper
Texture	Crisp	Cracky
	Crumbly	Wafer biscuit
	Mealy	Baobab powder
Color	Green	Mint sirup
	Black	Coal

2.2. Methods

2.2.1. Survey methodology

These investigations were carried out according to the method of Watts and al [5] and consisted in collecting a certain amount of information from people (around a hundred) made up of students from the Ecole Doctorale Polytechnique (EDP) and the Ecole Supérieure d'Agronomie (ESA) as well as staff from the INP-HB ESA. The questionnaire asked about preferences in terms of food tastes, flavors, textures, aspects and colors. The respondents were also asked about any dietary constraints or allergies they might have, and their level of interest in the project. These respondents were also asked to indicate their availability in terms of days and times when they could carry out a taste test, and a total of 100 questionnaires were distributed. Then, taking into account the conditions of eligibility, i.e. food preferences, allergies, availability and interest in the project, but above all any previous participation by the individual in at least one panel, a certain number of people were selected.

2.2.2. Theoretical jury training

This training was carried out using the method of Watts and al. [5] and the definitions described by Thomas [6]. It took place in two stages, the first of which was based on a physical document distributed to the selected individuals. The parameters, i.e. :

- Definitions of sensory analysis,
- The importance of sensory analysis in the food industry,
- Neurophysiological aspects,
- Setting up a sensory group,
- The layout of a sensory evaluation laboratory,
- And the different categories of sensory analysis test,

Were explained to enable the selected group of tasters to understand the essential notions of sensory evaluation and to harmonize their individual knowledge. The second part of this theoretical training was dedicated to the general definition of descriptors (complex and simple) and to generating together (selected tasters and instructor) a list of complex and simple descriptors to be evaluated. This list of complex and simple descriptors was used as the basis for the rest of the training sessions.

2.2.3. Reviewing the sensory acuity of selected panelists

This part of the training involved assessing the basic sensory abilities of each panelist. After the selection phase (survey), the individuals (panel) selected were tested to determine whether they had "normal" sensory acuity. This was done by asking them to identify basic flavors and odors, as well as common textures, aspects and colors. A sample of the various common products listed according to Verdier's [4] method in Table 1 with a three-digit code was presented to each member of the jury in transparent glasses covered with plastic film. Common products in sample form were presented to each jury member. Each individual should be able to evaluate and identify each product on the notion sheet from the code. Sensory acuity was assessed in a single tasting session.

2.2.4. Evaluation of panelist performance

This part of the training was carried out immediately after the jury's sensory acuity had been checked, and was designed to assess the panelist's ability to differentiate between different concentrations of the same product, and to assign scores to these perceived sensations. It involved evaluating performance based on discrimination, repeatability and panel agreement (ISO Standard 8586-1, 1993). It was carried out according to the method of Watts and al [5] and involved presenting common products at different concentrations (three different concentrations) to the tasters. The different concentrations were prepared using reference values (example : 8 g sucrose dissolved in 1 liter distilled water). The different reference concentrations were considered to be the lowest concentrations. Three-digit codes were applied to each concentration of a given product, and each product was presented to the tasters in three different degrees of concentration. Common products (Table 1) were prepared the day before at three different concentrations and presented to the tasters. Each person received a sample of a given product, coded at each concentration level. The panel members were each given a rating sheet on which they were asked to rank the different products on an interval scale from 0 to 9. Classification was based on taste, aroma, texture, appearance and color. Each panelist should be able to recognize the product presented to him/her, differentiate between concentrations of that product, and assign a score (0-9) to the distinct concentrations (discrimination). The performance of the selected individuals was evaluated in two tasting sessions of the same products prepared under the same conditions.

For a given product and single descriptor, a panelist was considered repeatable if the difference between two measurements (two measurements of the same product at the same concentration) was less than or equal to two (2). And this panelist is said to be effective in terms of repeatability if it is reproducible for at least 70% of the descriptors.

For a given product and descriptor, the judge is in agreement with the panel as a whole when 70% of the difference (in absolute value) between the weighted average of the panel and that of the panelist (carrying out at least 2 tests on the same product) was less than the standard deviation of the panel (ISO Standard 8586-1, 1993).

2.2.5. How can jury performance (discrimination, repeatability and agreement) be improved during training?

The aim is to improve the performance of the individuals making up the jury when they have difficulty in recognizing and giving adequate marks to the products presented to them during performance evaluation sessions. During training, improving the jury's performance is the most important phase, requiring a great deal of attention, concentration and precision. This part of the training should be carried out in at least three tasting stages.

The first step is to involve the instructor in the tasting session, i.e., the instructor sits at a tasting table alongside the jury. Together, they discover the same products, taste them and give them an evaluation score. During the evaluation, each individual (instructor and jury) identifies the product and assigns a score to the tasted product according to his or her personal judgment. A deliberation is then carried out, and a unanimous mark (monitor and jury) is given for the product at the indicated concentration. This is known as the "memorization" phase, so that the next time the individual is faced with the same product at a similar concentration, he or she will be able to assign the same rating as that retained by the group as a whole.

The last two stages consist in checking the ability of each member of the jury to memorize a note for a given product concentration. To this end, the standard products used for training are prepared under the same conditions, with the same contractions, and presented to each member of the jury in the same packaging. At this level, the instructor no longer takes part in the tasting, but supervises the session. At the end of the session, the score sheets are collected, a deliberation is carried out in the absence of the jury, and comparisons are made with the overall scores on the basis of statistical processing.

The jury is judged capable of analyzing the target product (product for which the training takes place), when the ratings given by each panelist to the different concentrations of the training products (current products) are statistically close

to those of the overall ratings (monitor and jury). For a good judgment of the target product by the jury, this phase of the training must be repeated until the jury's scores (individual score) are statistically close to those of the whole

3. Results

3.1. Survey

Questionnaires were distributed to 100 individuals and 78 people were able to return a response, i.e. 78% of respondents: 56 men (71.79%) and 22 women (28.20%). Then, taking into account the conditions of eligibility, i.e. food preferences, allergies, availability and interest in the project, but above all any previous participation by the individual in at least one panel (initiated subject), 12 people were selected.

3.2. Theoretical training

The 12 individuals selected during the investigations underwent theoretical training, which involved familiarizing them with some of the key terminology used in sensory evaluation, and developing a list of complex and simple descriptors. Approximately four complex descriptors (Appearance, Texture, Aroma and Taste) and 24 simple descriptors were generated. The list was presented as follows:

- Appearance: smooth, rough, then green and black for color aspect,
- Texture: crunchy, crumbly and floury,
- Aroma: fruity, floral, herbaceous, hazelnut, spice, lemon, mint, mushroom,
- Taste: bitter, sweet, salty, pungent, sour, umami, acidic, astringent and refreshing.

3.3. Review of the panel's sensory acuity

The results obtained at this stage indicate that over 50% of tasters have normal sensory acuity (Figure 4). This means that these tasters can move on to the stage of testing their ability to distinguish different levels (different concentrations) of a sensory characteristic. This first phase of practical training allows us to identify each panelist's basic skills on an individual basis. It is often used to better diagnose the panelist's shortcomings before verifying his or her performance.
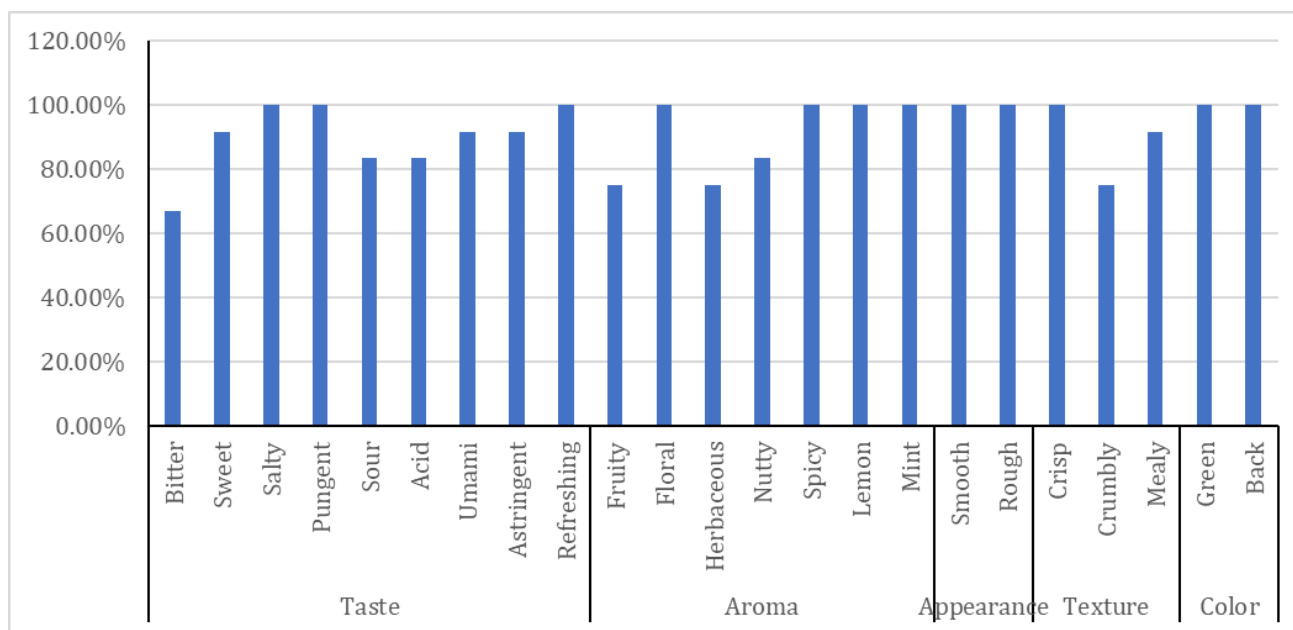

Figure 1 Sensory acuity assessment of selected tasters

3.4. Checking panel performance

Evaluation of the panel's discrimination performance revealed that 95.11% to 99.51% were able to distinguish between the concentrations of the products presented to them. Figures 2 and 3 show the results of the repeatability check and jury agreement. These data show that the jury was not effective in terms of repeatability for taste (64.36%), texture

(53.70%) and appearance (67.36%). However, it was repeatable in terms of aroma (71.83%). Each panelist agreed with the panel for taste (91.67%), aroma (95.25%), texture (80.56%) and appearance (95.83%).

However, the panel was not repeatable in terms of taste (64.36%), texture (53.70%) and appearance (67.36%). In fact, repeatability is one of the characteristics of sensory evaluation, which requires time to learn and memorize the intensity of the perceived sensation.
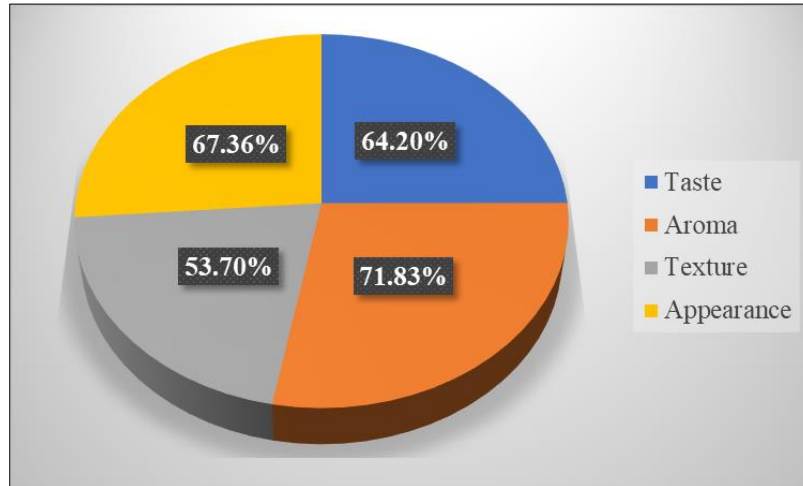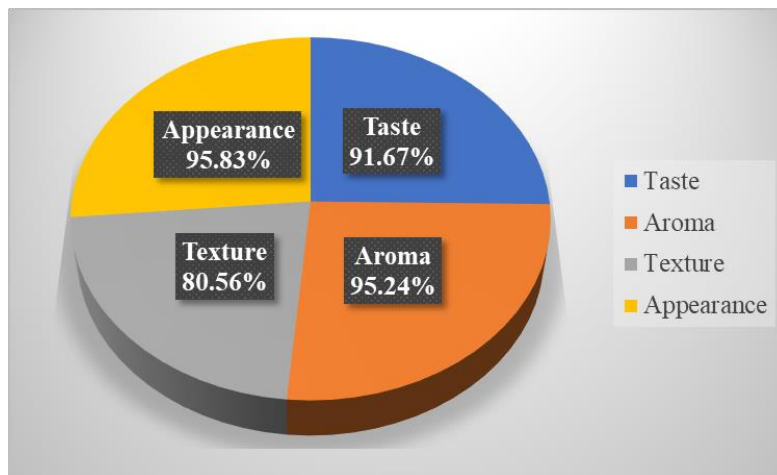

Figure 2 Checking jury repeatability

Figure 3 Checking jury approval

3.5. Improving jury performance

Figure 4 describes the three tasting sessions used to improve jury performance. The jury performance improvement phase focused on repeatability. The first session (with results of 100%) involved unanimous memorization of the scores assigned to the products analyzed. The second and third sessions tested the jury's ability to memorize, with values ranging from 87.27% to 100%. After the memorization phase, these panelists were said to be efficient in terms of repeatability for over 80% of descriptors.
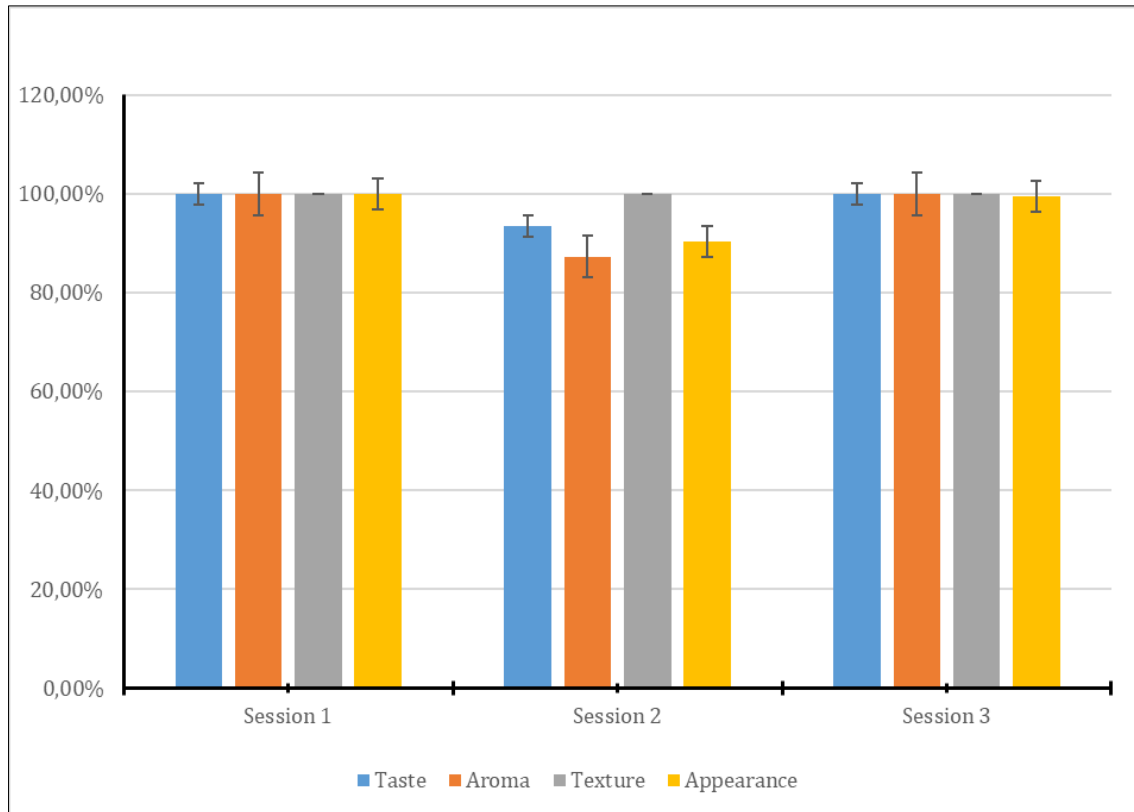
Figure 4 Improving jury performance

4. Discussion

The individuals selected were 5 women and 7 men. According to Watts et al. [5] and Strigler and al. [7], selecting 12 to 15 individuals for training could demonstrate superior performance during testing. Subsequently, the final group to be retained after full training should consist of at least 8 panelists with the ability to distinguish differences well, as required for the task at hand [5]. Taking into account the number of simple descriptors selected, the 24 products listed in Table 1 were prepared and presented to the jury at each stage of the various practical training courses. Generally, 20 simple descriptors are recommended [8]. However, in the case of this study, 24 simple descriptors were used, as the jury drew up this list and demonstrated the ability to evaluate them. According to ISO Standard 8586-1 (1993), the panel was able to differentiate between the 24 products, with over 70% (95.83%) in agreement. This could be explained by the fact that the selected panel was made up of experienced people, i.e., each panelist had participated at least once in a sensory analysis test.

5. Conclusion

A sensory evaluation test consists of several stages : screening, theoretical training, sensory acuity verification, performance verification and performance improvement. These different stages are consecutive and require personal application to better judge the target product.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflicts of interest regarding the publication of this paper.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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