The science and practice of sensory analysis

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Some of the key issues of developing innovative oral delivery formats are concerned with the taste, texture and mouthfeel of the products. The sensory experience is crucial when working with user-friendly delivery formats that spend more time in the mouth, i.e. lozenges or chewing gum, among others. From the first appearance and first chew to aftertaste, the delivery format has to offer a pleasant experience that appeals to the target user.

Sensory analysis has therefore become an essential part of developing, testing and marketing nutraceutical and pharmaceutical products. The different analyses that are part of the sensory evaluation are invaluable tools in many different processes, e.g. product development, when changing one or several ingredients, in consumer testing and quality control, in shelf-life analysis or when production processes are changed.

In other words, sensory analyses should be considered as an integral part of developing effective and pleasant oral delivery formats. But what is sensory analysis, what do sensory analyses comprise, how is a sensory evaluation set up, and what are the benefits of this kind of careful analysis? This article seeks to provide some of the answers to the scientific method of sensory evaluation and the practices around it.

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The complexity of sensory analysis

In the case of oral delivery formats such as chewing gum, lozenges or chewable tablets, the sensory analyses comprise all senses, i.e. touch, sight, hearing, smell and taste throughout the life cycle of the product (Fig. 1). What is the colour and size of the product, how does it sound when chewed, does it create a burning sensation in the mouth or throat, and what is the flavour like, is it sweet enough or maybe too bitter?

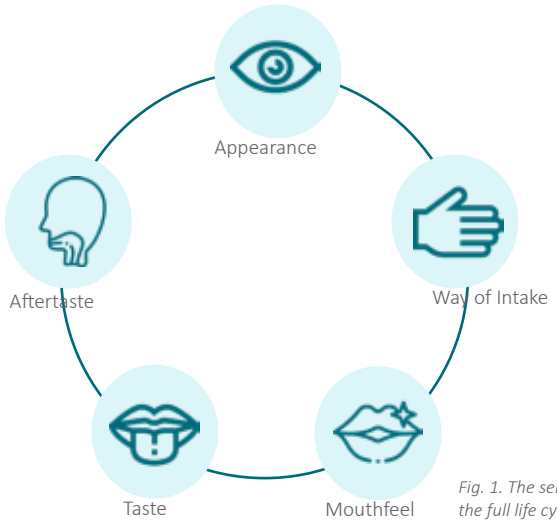
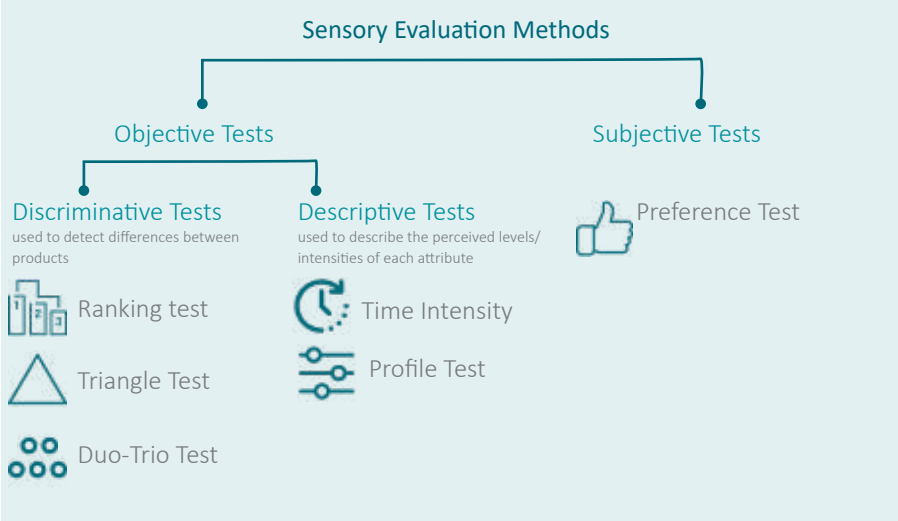


Fig. 1. The sensory analysis considers the full life cycle of the product

All these factors tend to impact consumer preference and choice of product. Sensory impressions and preferences are, however, highly subjective and make sensory analysis quite complex. The human sensory system registers thousands of nuances in any sensory experience, which makes it difficult to establish the objective criteria needed to create successful formats and formulations for human consumption.

The extreme sensing capabilities of humans are difficult to emulate with technology. Progress is made in experimenting with for instance electronic noses or tongues, but the industry has to rely as well on human perception in sensory evaluation.

With the growing interest and demand for products with active ingredients aimed for preventive or treatment purposes, sensory analysis has developed into a science that provides an objective understanding of the sensory properties of products, and the consumer response to these properties. Consequently, a lot of effort is put into establishing objective criteria in sensory evaluation performed by human beings by the use of trained sensory panels.



Examples of attributes measured in sensory evaluation:

- Flavour intensity – immediate and over time
- Astringency
- Crunchiness
- Chalkiness
- Burning sensation
- Bitterness
- Cooling intensity
- Sweetness
- Salivation
- Volume
- Softness

Fig. 2 Examples of sensory evaluation Methods used in Fertin Pharma

The art of sensing – sensory panels in practice

Sensory panels with trained panelists are widely used in the food industry as well as in the nutraceutical industries to define product characteristics such as flavour and texture of products. However, the use of sensory analysis is infrequent for pharmaceutical products.

The industry typically distinguishes between two types of panels: 1) consumer panels, used to test the final product among target consumers for liking or preference; and 2) trained panels, used to establish objective criteria that can be used in for instance product development processes.

For all types trained panel tests, a high degree of professionalism, experience and insights into sensory science is required. In the following, we will focus on the use of trained panels, i.e. how the panel is trained and how a typical panel session takes place at Fertin Pharma, a leading CDMO in oral delivery platforms.

Training and medical approval

Before joining the panel, careful screening of the individual panelist takes place. The prospective panelists take part in a 3-day theoretical and practical training session that is concluded by different tests to make sure that the required sensory capabilities are in place. When the panelist has passed the test, participation in the panel has to be approved by a doctor to make sure that the testing activities does not in any way impact the general health of the person. Any tests involving pharmaceutical products are conducted in compliance with requirements from local authorities.

Typical panel session

In order to evaluate on the taste and texture of newly developed samples, representatives from the development and sensory teams discuss the purpose of the test and select the test method that best fits the purpose. For instance, if a new raw material has been used, a descriptive test will be the most appropriate in order to identify any differences based on a reference sample.

Fig 3. The participants of the sensory evaluation perform a value calibration

Fig. 4 The sensory evaluation is performed in neutral surroundings with no external stimuli. Participants are isolated in individual booths to avoid interaction.

Subsequently, the sensorial attributes to be studied are defined, as well as the duration of the test. For example, if the purpose of the test is to compare the coating of a product or taste masking of the initial taste, a 5 minute session will be enough. Whereas 15 minutes are needed in order to comparing the softness of a chewing gum.

The panel typically comprises 6-10 trained assessors for a session. After a value calibration session, the sensory evaluation is performed in neutral surroundings with no external stimuli, and participants are isolated in individual booths to avoid interaction.

The samples are anonymized, and one product is tested at a time. The panel evaluates the samples at regular intervals using a unipolar, unstructured scale. All samples are replicated, and the same panel evaluates all replicates.

Use of data

All data is collected and analysed by means of computer software and advanced statistical methods in order to define the statistical significance between the products across parameters. After evaluation and acceptance of the assessor performance, the results are documented in the final report (Fig. 5, Fig. 6). Sensory experts interpret the test results and

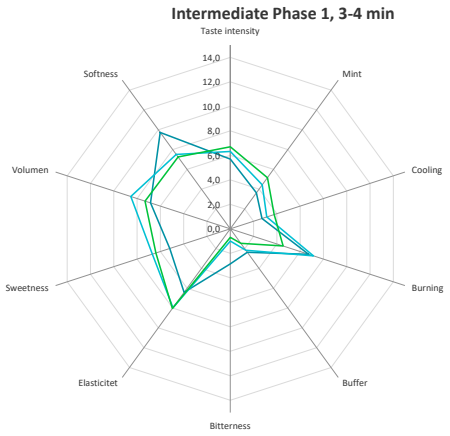


Fig. 5 Example result from a profile test

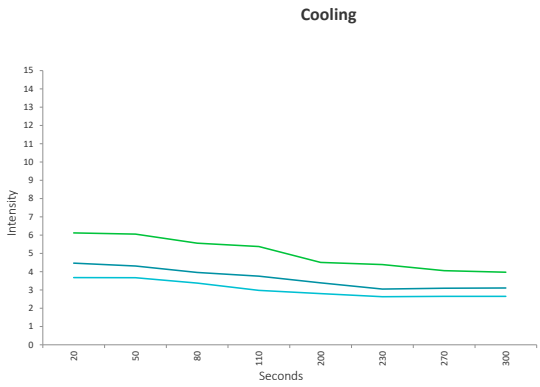


Fig. 6 Example results from a time intensity test

use the conclusions in the further development of the products.

Case story:

Sensory evaluation in practice

A leading pharmaceutical company wanted to develop a new nicotine gum product, using a competitor product as reference.

The first decision was whether to build on an existing gum formulation or introduce a new formulation. The initial analysis included three different samples (A,B & C) compared to a target product:

1. The existing gum formulation coated with two different coatings (products B & C in the below charts)
2. New gum formulation (product A in the below charts)
3. The target product

Products A, B & C were then compared to the target sample, using a time intensity test that would uncover the taste and texture of the different products over a period of 20 minutes.

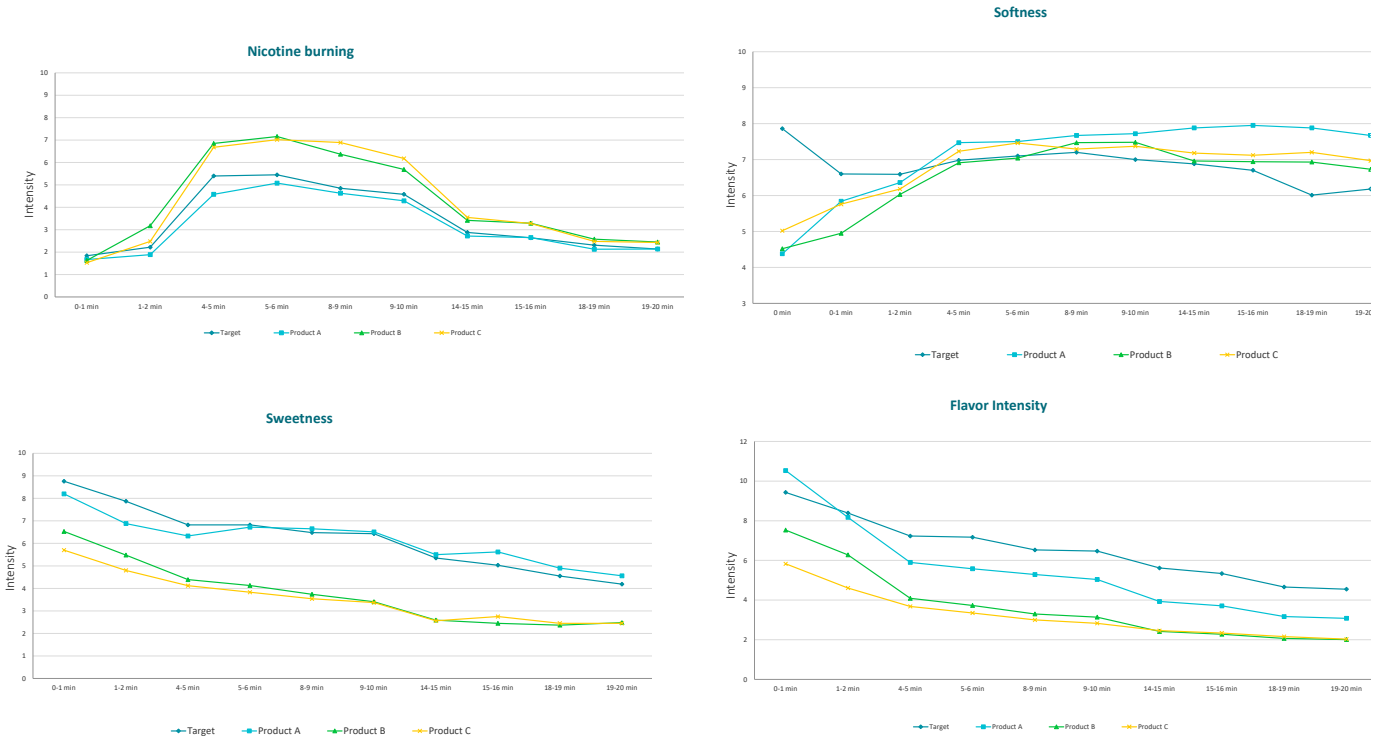


Fig 7 Results of the sensorial test of products A,B,C against target product

The results showed that the new gum formulation (A) matched the target product better than the existing formulation as regards nicotine burning and sweetness. With respect to flavor intensity, the new formulation did not quite match that of the target, but it was closer than the existing formulation. The initial softness of the gum formulation did not match that of the target gum, but after 2-3 minutes and until 8-9 minutes of chewing, both gum formulations matched the target.

The results of the first sensory evaluation were then used in the further formulation development with a view to optimizing flavour levels and softening of the initial chew. For the next sensory evaluation, the product was very close to hit the desired target on all parameters.

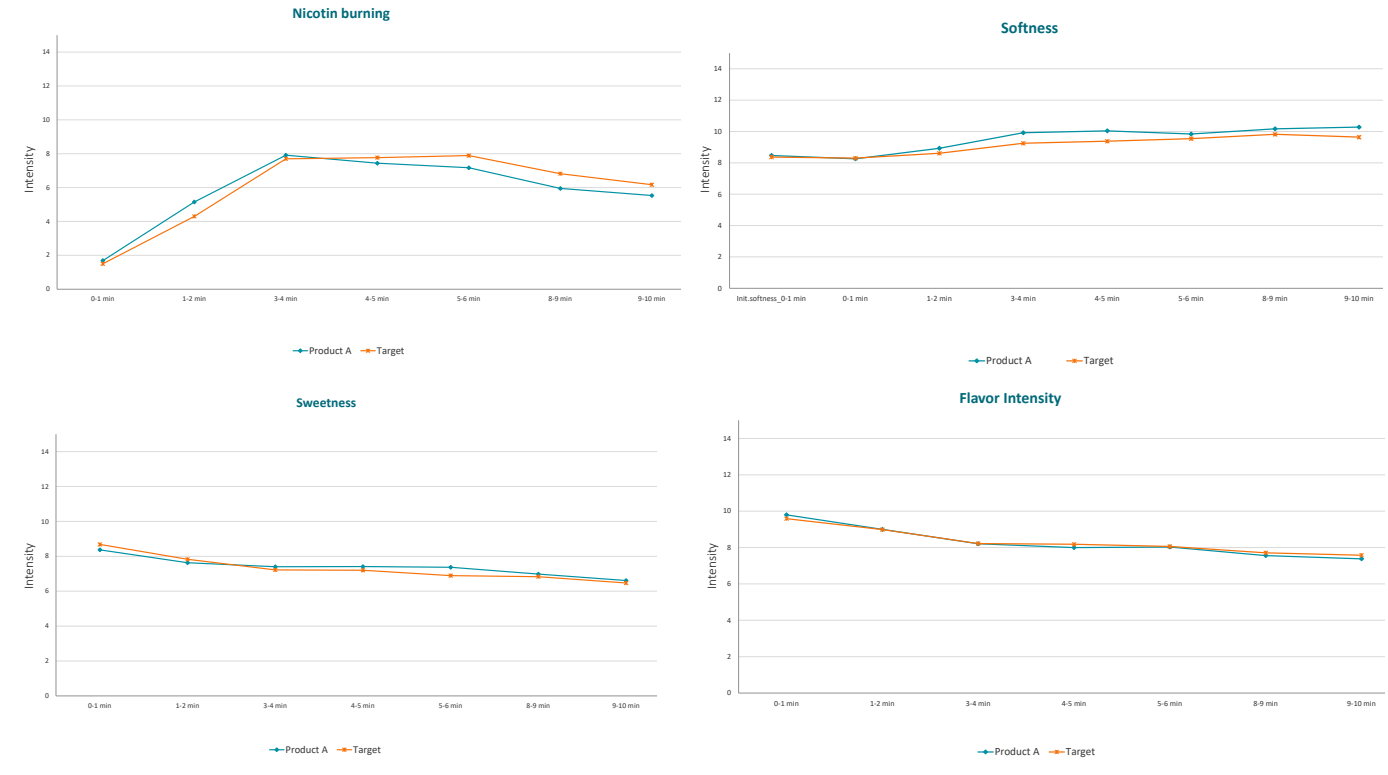


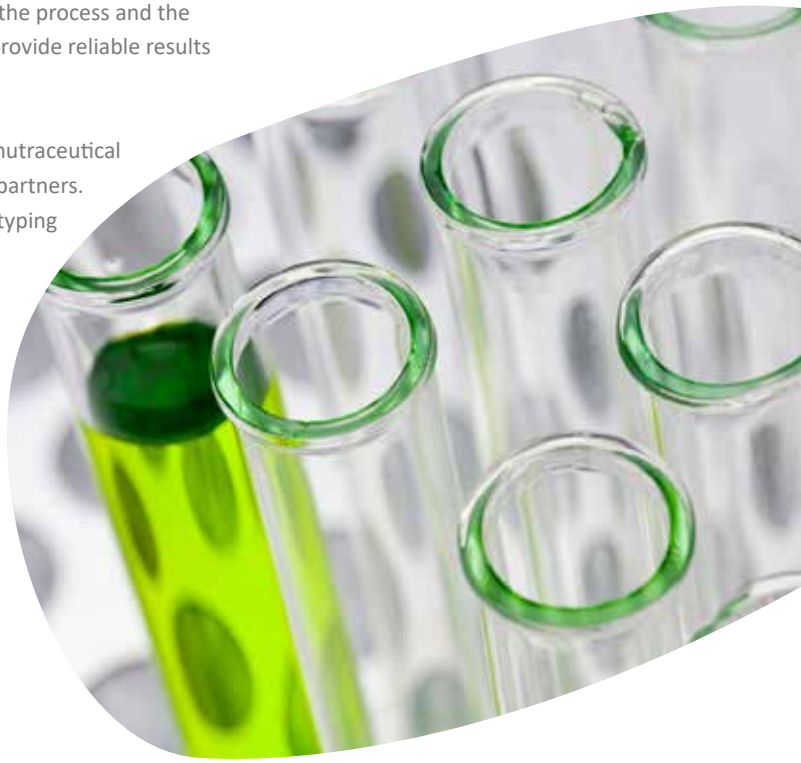
Fig 8. Results of the sensorial test of optimised prototype and target product

Using sensory data to develop consumer-friendly products

During the development of delivery formats designed to stay in the mouth longer, the sensory experience plays a key role in user acceptability. Hence, careful attention must be paid to the sensory characteristics of the product.

The combination of objective and subjective sensory analyses provide deep understanding and information about specific features of a particular product. It is extremely important that the evaluation scheme is constructed and carried out in the right way to get the right outcome. The choice of testing methods must be considered early in the process and the elements of the evaluation process have to be balanced carefully to provide reliable results within the required cost and time framework.

Given the complexity of the sensory evaluation, pharmaceutical and nutraceutical companies choose to outsource the sensory analyses to their CDMO partners. Integrating the sensory analysis into the product development, prototyping and manufacturing processes secures timely and relevant input to adjust formulations and formats to achieve the desired product and a successful market launch.



About Fertin Pharma

Fertin helps leading global brands create pharmaceutical and nutraceutical products to support healthier living. We develop and manufacture innovative oral and intra-oral delivery systems that enhance the efficacy of your active and functional ingredients – without compromising on taste-masking, texture and the consumer experience.

Our heritage from the confectionery industry and a successful track record in the consumer healthcare industry, enables us to give customers best-in-class service from product development to commercial supply.

With more than 800 employees across our R&D centres and manufacturing facilities in Canada, Denmark and India, we produce approximately 3 billion units a year, used by consumers all over the world.

Fertin was acquired by EQT Mid Market (private equity) in January 2017. The founding family, Bagger-Sørensen, retains a 30% interest in the company.