

DLG Expert report 12/2018

Practice guide for sensory panel training

Part 2: Training plans for sensory assessor and panel qualification



Part 1 of the DLG Expert report, 'Practice guide for sensory panel training – Requirements in accordance with DIN EN ISO 8586:2014-05', was concerned with describing and explaining the specifications of DIN EN ISO 8586 for training sensory assessors. Part 2 aims to introduce specific training plans including examples of reference materials both from DIN EN ISO 8586 and from practical application that can be used as suggestions for company-specific training plans. The tests conducted, and the substances, substance concentrations and foods that are used in this process, are to be regarded as examples. They must be tailored or adapted to internal requirements depending on the respective training objectives, the sensory assessors' qualification level or the food groups that are to undergo sensory analysis. Hedonic test methods are therefore only listed in some of the training plans in order to introduce the methodology and enable it to be used in consumer tests or for designing such tests. Tests such as these are never conducted with trained personnel!

1. General notes on sensory panel training

Sample management and 'good sensory analysis practice'

In accordance with the rules of 'good sensory analysis practice', all of the samples used for training must always be presented at the same temperature, in the same quantity and in anonymised form, i.e. in identical sample containers and encrypted with random 3-digit numbers as well as being randomised if necessary. If there is a risk that the sensory assessors could mutually influence one another due to spatial circumstances, different codings must be used, at least for persons sitting next to each other. The training courses should preferably be conducted in a sensory analysis laboratory in accordance with DIN EN ISO 8589 or a room that at least meets the essential requirements in this regard should be selected (see DLG Expert report 7/2017, point 1.2., p. 4 ff.).

Definition of training objectives and role of the panel leader

The panel leader plays an important role in training courses that are aimed directly at conducting sensory analyses (in a company, institute or the like). Together with colleagues from product development or quality assurance, he/she must first formulate the respective project objective and the issues to be clarified, and must select the product samples to undergo sensory analysis as well as a suitable test method.

As is also described in DIN EN ISO 8586 (and in DLG Expert report 7/2017, 'Practice guide for sensory panel training – Requirements in accordance with DIN EN ISO 8586'), the panel leader must define the requirements for the sensory performance of the sensory assessors, i.e. define which essential capabilities are crucial to the selection of sensory assessors and which minimum requirements have to be made on the respective sensory test results of the prospective sensory panel members, before preparing a selection and training concept for the sensory assessors. Actual sensory assessor preliminary selection and training can only begin once a nominal/actual comparison regarding sensory assessor performance is possible and an evaluation standard for sensory assessor selection and sensory panel compilation is available. The reason for this is that an ability to discriminate (sensory assessors and panel), reproducibility (homogeneity of the test results in the sensory panel) and repeatability (reproducibility of the sensory assessors and panel), etc. are essential elements of the range of requirements for sensory assessors and panels in food sensory analysis in order to achieve reliable results in sensory product assessment. It should be noted that the authors refer only to sensory assessor requirements here. Further requirements such as health suitability, availability and team skills, etc. also play a role. Sensory assessor recruitment, preliminary selection and training (general sensory and methodological training, product-related training) only begin once the requirements for the sensory assessors have been agreed on.

Result backup and data management

Since high volumes of data are generated during the sensory analyses in the form of test results that enable conclusions to be drawn regarding both the sensory product characteristics and the sensory sensitivity, performance and reliability of

the sensory assessors, the panel leader is well advised to use appropriate IT to support data collection and evaluation. The literature overview at the end of this publication lists a selection of software programmes, but corresponding tools in MS EXCEL can also be used in many areas.

2. Handling the example training plans

Various examples of training plans are provided in the following; both the content and the scope of their training units differ due to the respective application areas and target group(s).

The training units that **constitute the training course** (see training plans in Annexes A and B), e.g. for students in bachelor and master study programmes at universities, are usually very extensive, as they cover the entire range of food sensory analysis methods in order to ensure the broadest possible qualification and good preparation for the subsequent professional requirements in the sensory analysis sector.

Conversely, training plans for **employees at companies** (see training plans in Annexes C to E) are usually focussed on the respective project issue and the resulting requirements for the sensory assessors and panel members; therefore, their scope only covers partial areas and their content is less extensive. In this regard, the following are portrayed in the this DLG Expert report publication:

- a qualification course with a maximum of three stages according to the specifications of DIN EN ISO 8586, consisting of basic and advanced training as well as an introduction to product-specific training,
- a possible training plan including examples of possible training contents for establishing a descriptive sensory panel,
- an approach that is suitable especially for small and medium-sized companies for establishing a discriminatory sensory panel for sensory quality assurance that meets the minimum requirements of both DIN EN ISO 8586 and the common food safety standards (IFS Food, BRC Global Standard for Food Safety, FSSC 22000, etc.).

All three examples, which are focussed on the target group of employees in companies, include important sensory methods and skills that are used in the context of both quality assurance and product development in operational practice.

The sensory assessor training pyramid shown in Figure 1 is intended to provide the reader with an orientation aid and help to select the appropriate training plans. The figure breaks down the training content described in the Expert report publication; however, it does not specify a sequence of training plans to be worked through from A to E. Instead, the overview shows the different breadths and depths that the various sensory assessor training approaches described here pursue. The target group to be trained is also listed in addition to the training scope with reference to the application area or training purpose. The respective training plans and units must always be selected by the project managers and depending on the requirement profile for the sensory assessors and panel members.

The training plans in the Annex are structured in tabular form. They each show the 'Objective' and the 'Method', and offer examples of practical exercises including possible training references in the 'Implementation' column. The link to the underlying standards (particularly DIN EN ISO 8586) and the modules in the DLG 'Practice guide for sensory panel training', Part 1, is ensured by means of corresponding references. Thanks to the modular structure of the training plans, it is generally possible to take individual elements from the respective training material and integrate them individually into internal company training projects. As described in DIN EN ISO 8586, each training plan consists of two main elements: preliminary selection of the sensory assessors and the actual training course. The latter can, for example, be concluded with a test (final test), in which each sensory assessor demonstrates his/her sensory suitability for working in a sensory panel. Subsequent to this, it is important for the trained sensory assessors to regularly verify their performance in the context of sensory panel monitoring. Such reliability tests enable the assessment of the entire sensory panel's reliability as a 'measuring instrument'.

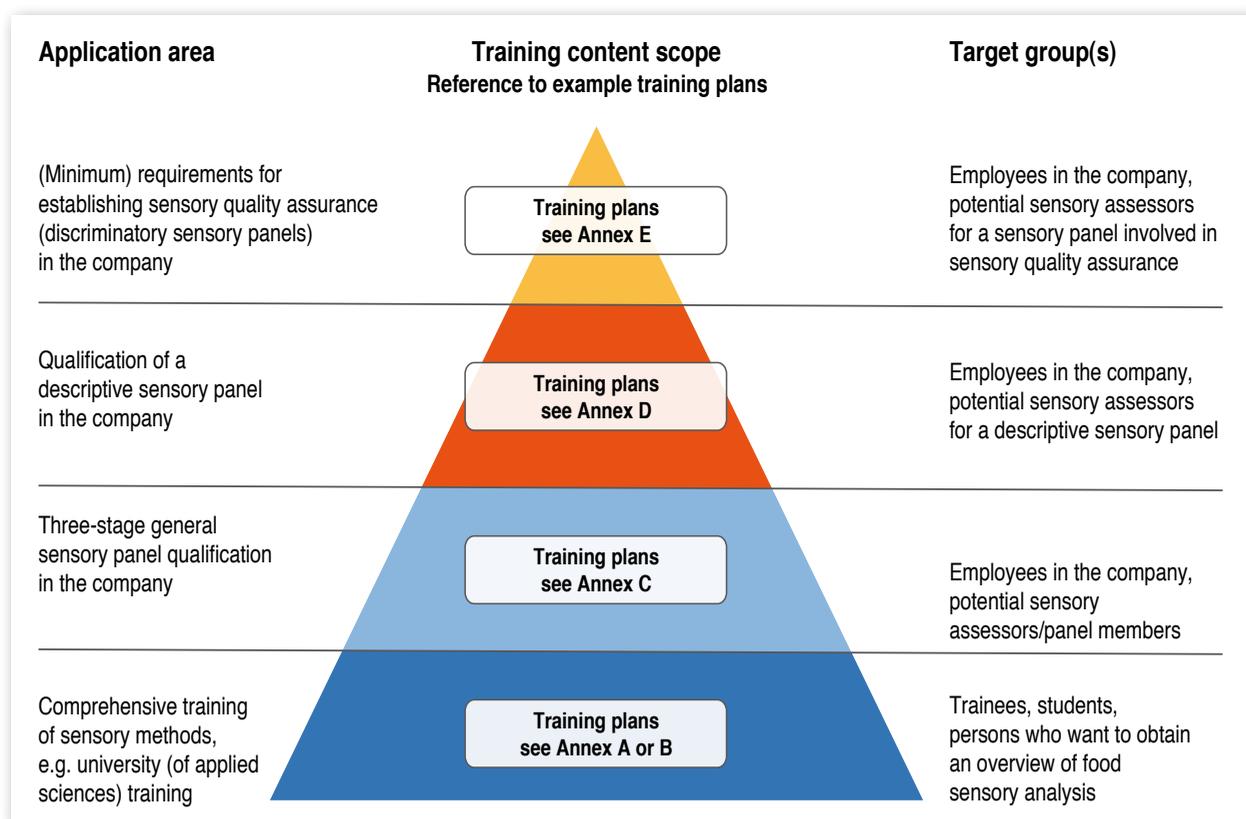


Figure 1: Sensory assessor training pyramid

The authors have consciously cited the relatively complex training plans from the university study programmes (at the base of the pyramid) as well, because it is precisely from this extensive wealth of experience that individual elements can be picked out for practical application and compiled in company-specific training concepts. They are therefore first and foremost also to be regarded as a valuable pool of ideas. The pyramid shows the training plans according to the breadth of their content. In terms of depth, with regard to the duration and intensity of the training on individual methods or sensory attributes to be recognised and quantified, training courses in companies or institutions are usually more demanding than those in the context of studies at universities. While the former are aimed at practical application as part of specific projects or daily operations, the latter are concerned primarily with an overview of the sensory analyses as a whole in addition to fundamental or basic training with respect to sensory perceptions.

3. Training plans incl. training references in detail

3.1 Sensory training courses as part of studies using the example of a full-time ecotrophology study programme

3.1.1 Basic training with final test in the Bachelor study programme

(Annex A, Table: 3.1.1-1 to Table: 3.1.1-11)

The training plans described in Annex A Table: 3.1.1-1 to Table: 3.1.1-11 (source: Prof. Dr D. Hanrieder and Dr M. Brandt, Anhalt University of Applied Sciences) include a review of the sensory capabilities of sensory assessors and their training in weekly training units of 90 minutes each over the course of a semester. In this process, fundamental sensory analysis methods are also presented (not trained) and conducting them is demonstrated on the basis of example foods. The exercises are concluded with a final sensory test, see Annex A, training unit 11 (Table 3.1.1-11). In parallel with the practical exercises, theoretical knowledge on the anatomy of the sensory organs, sensory physiology and psychology as well as the selected test methods, their experimental preparation and application and the evaluation of the results is conveyed in lectures.

3.1.2 Advanced training with final test in the Master study programme

(Annex B Table: 3.1.2-1 to Table: 3.1.2-7)

The structure of the training plan in the Master study programme, which can be found in Annex B, Table: 3.1.2-1 to Table: 3.1.2-6 (source: Prof. Dr D. Hanrieder, Anhalt University of Applied Sciences), is similar to that of the Bachelor study programme. The senses are tested again and trained over an entire semester. Examples of a range of test methods are also presented in the practical exercises (90 min. each); some of these are the same methods as in the Bachelor study programme, some are variants of methods that are already familiar and some are new methods. The results of these tests are also evaluated using statistical methods in accordance with the existing standards or with the specialised literature. Lectures (30 hours) dealing above all with the topics of design of experiments, knowledge and selection of methods, result evaluation, sensory assessor selection, sensory panel training as well as sensory assessor and panel monitoring take place in parallel throughout the entire semester.

Training unit 1 (preliminary selection of sensory assessors) is identical in the Bachelor and Master study programmes. With regard to the subsequent exercises, only the test methods practiced on the basis of specific foods are listed here. As in the training plan for the Bachelor study programme, these are supplemented in each training unit by methods for training the sensory perceptions in terms of odour, taste and texture. The foods used in the tests were selected as examples and can be exchanged with others as required. If the object of the test is product differences in terms of odour, taste or texture, it must be ensured either that the samples have the same appearance or that the influencing factor of appearance is eliminated by dimming the light, coloured light in the booths or other measures.

It must be noted that the test methods in this context are only presented in terms of the test methodology. Genuine training can only be achieved by means of repetition multiple times. Some methods (quality testing) necessitate extensive product knowledge, the communication of which is not the object of this training plan. The performance of the final test in the Master study programme is similar to that of the test in the training programme for the Bachelor study programme, see Annex A, Table 3.1.1-11 final test, Bachelor study programme, training unit 11.

3.2 Sensory training courses in companies

In order to be able to use internal personnel for sensory analyses – either persons from various areas of the company (internal sensory panel) or persons recruited from the general population (external sensory panel) – in the context of product development or quality assurance, these persons must be tested and trained in terms of their sensory skills. Corresponding proof of training is also often required in connection with quality management system certification and as part of food safety standards (IFS, BRC, etc.). Demand for sensory training courses as an external service is therefore increasing amongst small and medium-sized companies, while major companies usually organise these themselves.

Training by external service providers can be carried out either on site at the company (in-house training) or at the service provider's premises, which are usually also equipped with a sensory analysis laboratory. Participants in the in-house training, which is organised as further company training and aimed at company-specific needs, are all employees of the company or a network of companies (e.g. a company group or the like). Alternatively, employees can also take part in open, cross-company seminars in order to obtain corresponding sensory qualifications. In the context of sensory training courses, it is sensible to not only conduct practical tests, but also to combine these with the communication of fundamental knowledge. Amongst other topics, this should include the function of the sensory organs involved in sensory analysis, possible errors in sensory analyses as well as their causes and avoidance, and/or knowledge about relevant test methods and their correct implementation. Ideally, future panel leaders and sensory panel members can be trained separately in order to give better consideration to the different tasks and requirement levels. Wherever possible, the training should switch between theoretical content and practical exercises in order to avoid sensory fatigue.

However, such training courses conducted by an external service provider or participation in external courses are not sufficient by themselves. They merely constitute a start and an introduction to the topic by providing the participants with

fundamental theoretical knowledge and practical skills in the field of sensory analysis. The future panel leaders and sensory panel members additionally learn how they can subsequently structure their own training courses independently. Depending on the complexity of the company's products and the type of sensory analyses intended or the issues to be processed, these usually have to be conducted over a period of a few weeks at first in order, in the case of the sensory panel members, to train adequate sensory capabilities and skills through continuous repetition and therefore to enable them to work as reliable 'measuring instruments'. The more complex the products, the higher their number and diversity and the more demanding the test methods to be used are, the greater the training effort. It must also be clear that a sensory panel is not then trained for all eternity. People's sensory capabilities can change over time as a result of age, illness and medication, etc. Conducting a check at least once a year is therefore advisable. Methodological skills can be lost if a method is not practiced for a long time (e.g. profile analysis in descriptive sensory analysis), new products with which the sensory panel members are not yet familiar could be introduced and new persons could also follow on as panel members. All of these necessitate retraining time and again.

In general, it should once again be pointed out that, in accordance with DIN EN ISO 8586, each person who takes part in tests is a sensory assessor. At the point in time at which the sensory assessor's sensory capabilities are screened, he/she is termed a selected sensory assessor. He/she only becomes an assessor or expert sensory assessor on completion of a training course including a successful examination. This therefore establishes the basis for forming a sensory panel (group of sensory assessors/expert sensory assessors), whose sensory performance must be subjected to regular monitoring.

3.2.1 Three-stage general sensory panel qualification in the company

An example of a training programme, subdivided into basic and advanced training, is presented in the following. It was implemented on two training days at an interval of approximately three months as a service for persons from various food companies (source: Prof. Dr D. Hanrieder, Anhalt University of Applied Sciences). Since this type of training course is concerned with fundamental sensory capabilities and skills, it poses no problem if persons from different areas of a company (in the case of internal in-house seminars) or from various food industry sectors (in the case of open, external seminars) take part in it. On the contrary – this is always considered pleasant and beneficial to mutual exchange by the participants. The foods used in the tests, including those in the subsequent training plans, were selected as examples and can be exchanged with others as required.

3.2.1.1 Basic training (training day 1)

(Comparable to the preliminary selection of sensory assessors)

Example training plan, see Annex C, Table: 3.2.1-1

3.2.1.2 Advanced training (training day 2)

(Comparable to the training of selected sensory assessors)

Example training plan, see Annex C, Table: 3.2.1-2

3.2.1.3 Product-related training (introduction to the topic using the example of sugar)

(Roughly comparable to the introduction to product-specific training for selected sensory assessors)

In accordance with DIN EN ISO 8586, product-related sensory analysis training involves the intensive exposure of the selected assessors and potential sensory panel members to the sensory attributes of the products offered in the respective company's portfolio or to the product range that is to be analysed in detail in the subsequent sensory analysis project. It is generally the case that a more in-depth product-related training course has to be carried out independently within the company or under the expert charge of the responsible project manager in the company.

Consequently, the approach described in the annex can serve as an initial step in this regard. The objective of the product-related training course outlined there as an example (source: Prof. Dr D. Hanrieder, Anhalt University of Applied

Sciences) is to make their own company's products, in their pure form or in varying formulations, more tangible to employees from the company's different divisions on the basis of sensory tests using various test methods. The training was designed for employees from various divisions of a major company that manufactures sugar and sugar products by the Anhalt University of Applied Sciences in coordination with the company's project manager. Several days of training with repeated sensory product analyses usually have to be planned for such technically more detailed product-related training courses in order to reinforce the training effect and successively deepen the employees' sensory product knowledge. Example training plan for an introduction to the topic, see Annex C, Table: 3.2.1-3

3.2.2 Qualification of a descriptive sensory panel

Descriptive sensory methods are used at companies, research institutions and universities, etc. to be able to describe product characteristics, in particular, as precisely as possible on the basis of sensory profiles and to subsequently compare them. The following chapter outlines a training concept for qualifying a descriptive sensory panel. Due to the variety and complexity, the individual steps are specifically explained and transferred to example training plans. Again, the foods used in the tests were selected as examples and can be exchanged with others as required.

Like discrimination tests, descriptive tests are considered to be analytical sensory methods. The objective of descriptive tests is to identify, label and, if necessary, also measure the intensity of human perceptions with regard to the appearance, odour, taste and texture of foods. In the latter case, the qualitative sensory description (sensory vocabulary) of the product is followed by the quantification of the intensity of each descriptive attribute with the aid of scales. This enables the establishment of individual product profiles that help to characterise and differentiate products in sensory terms. Descriptive methods are a valuable instrument for product development and quality assurance, because they support both recipe design and quality monitoring. They are usually used to compare similar products within a category (e.g. competitive comparison in sensory market research) or products with modified recipes (e.g. product development). However, the profiles of products from various production lines, from different production dates or of varying storage durations can also be compared using descriptive sensory analysis in the context of quality assurance. Using statistical methods (e.g. preference mapping) to combine the profile data of products (sensory analysis) with the results of popularity tests (hedonics) enables the subsequent determination of which product characteristics lead to rejection or acceptance amongst consumers, thus making corresponding adaptations to the recipe possible.

Descriptive sensory analyses are the most demanding analytical methods in food sensory analysis. Methods such as the consensus profile (previously DIN 10967-2-2000, currently DIN EN ISO 13299-2016), the conventional profile (previously DIN 10967-1-1999, currently DIN EN ISO 13299:2016) or also the Quantitative Descriptive Analysis (QDA®) and the Spectrum™ method belong to the intensity-based methods that, like a measurement with a precisely calibrated measuring instrument, are carried out exclusively with trained sensory assessors (expert sensory assessors). In these methods, the sensory assessors all use jointly defined attribute and definition lists to evaluate the same product-relevant attributes that they have developed and defined beforehand in group work. In addition, they all use the same intensity scales during the subsequent product profiling.

Use of the respective method is intensively trained beforehand. Due to the fact that several training units are almost certainly needed before the sensory assessors or the sensory panel can be deployed (depending on the product group and the sensory assessors' training status), the time and costs required for these methods are relatively high. Similar methods such as the 'free choice sensory profile' (previously DIN 10967-3-2001, currently DIN EN ISO 13299-2016) or 'flash profiling' operate with less extensive methodological standardisation, because both the description and the intensity rating are often carried out individually by each sensory assessor in this case. As a result of this, the training effort is reduced and modified, whereas the requirements made on the person who statistically evaluates the raw data increase. Quick descriptive methods are the subject of numerous research activities at present. So far, however, it has to be noted that the meaningfulness of the quick methods is not yet on a par with the results delivered by the traditional methods in many cases. Details on this can be found in DLG Expert report 5/2016 'Sensorische Analyse, Methodenüberblick und Einsatzbereiche, Teil 4: Klassische beschreibende Prüfungen & neue Schnellmeth-

oden' (Sensory analysis, overview of methods and application areas, Part 4: Classic descriptive tests & new quick methods).

As not all people are equally receptive to sensory stimuli, cannot describe and distinguish sensory attributes equally well and cannot reproducibly report on their intensity from the word go, comprehensive training of the selected sensory assessors is required after initial screening, particularly for the intensity-based descriptive tests. As described previously, at least twice the number of sensory assessors needed for a sensory assessor group should ideally be recruited, subjected to preliminary selection and integrated into the pool. In order to meet the recommendations of the DIN EN ISO standards and take into account the authors' experience in terms of personnel losses, appropriate numbers of sensory assessors must be included in the training courses so that a sensory panel size of $n = 12-15$ can ideally be achieved for the conventional profile and $n = 7-9$ for the consensus profile.

The following example of a training approach for such a descriptive sensory panel is focussed on the classic, intensity-based descriptive tests and is intended to provide sensory analysis practitioners and project managers in the food industry with suggestions and elements for internal company sensory panel training.

One prerequisite for participation in the sensory panel is that the sensory assessors are not averse to the products to be tested and that they have sufficient verbal skills to accurately describe sensory perceptions. The general requirements for sensory panel members in terms of health suitability, motivation, availability and reliability, etc. otherwise apply. The potential sensory assessors should already be roughly informed about their tasks during the acquisition phase. Detailed briefings are necessary prior to each of the selection and training units.

In the experience of the authors and also based on the procedure described in Chapter 2.1 of 'Praxishandbuch Sensorik in der Produktentwicklung und Qualitätssicherung', Behr's Verlag GmbH, the selection and training of a descriptive sensory panel take place according to the sequence shown in Figure 2.

As has already been mentioned, minimum requirements for the sensory assessor performance to be achieved must also be defined for descriptive tests when preparing a training concept and an advanced training plan for selected assessors and potential sensory panel members (see DIN EN ISO 8586 and DLG Expert report 7/2017 'Practical guideline for sensory panel training – Requirements in accordance with DIN EN ISO 8586'). Minimum requirements must be defined for each of the individual qualification stages, i.e. for both the pre-selection or screening stage and for the completion of the training phase, and ultimately also for the continuous monitoring. These specifications then serve as the evaluation standard for sensory assessor selection and the compilation of the sensory panel. The fact that the foods used in the tests were also selected as examples and can be exchanged with others as required also applies to the following training plans.

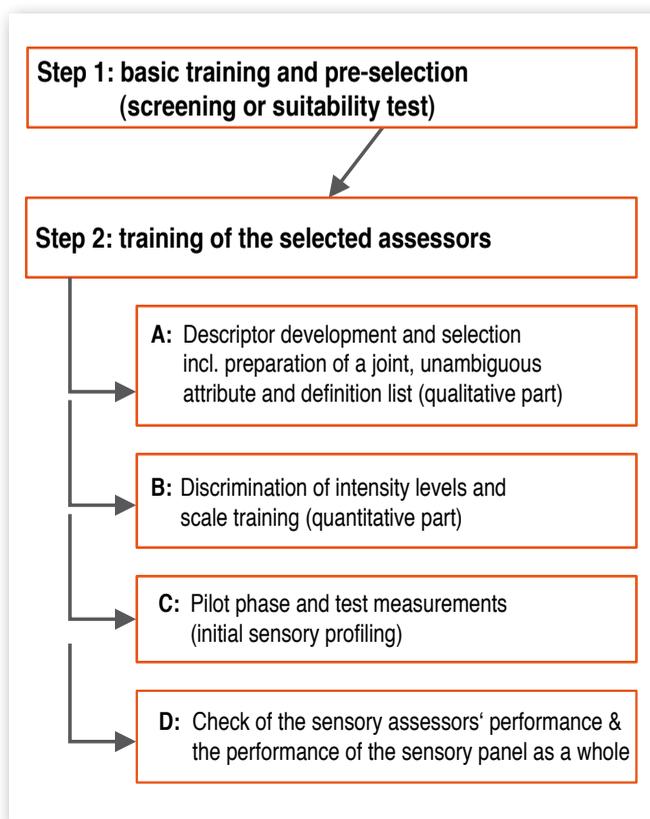


Figure 2: General sequence for the selection and training of a descriptive sensory panel

Step 1: basic training and pre-selection of the sensory assessors

Essentially, training unit 1 for the pre-selection of potential sensory assessors, i.e. for initial screening and a suitability test, is identical to the basic training plan in the Bachelor study programme (see Annex A, Table 1.1-1 Pre-selection of sensory assessors). If it subsequently forms part of the sensory panel members' tasks, an exercise on recognising differences in texture should be added and also, in each case, an exercise for registering the general verbal expressiveness and powers of description of the potential sensory assessors. The panel leader must also define minimum requirements for screening, i.e. for the selection of the sensory assessors.

Example training plan, see Annex D, Table: 3.2.2-1

Step 2: training of the selected assessors

A: Descriptor development and selection incl. preparation of a joint, unambiguous attribute and definition list
(qualitative part: uniform use of language / descriptors)

The objective of this exercise series is to develop a manageable number of sensory attributes and descriptors for a range of products that are unique, unambiguous and easily communicated for the characterisation of the product and which help to deliver an objective sensory description. This qualitative part of the method serves to establish uniform, standardised language use for describing the product in the subsequent sensory panel and in the planned test. The sensory assessors define a joint list of descriptors and definitions as a type of content-based 'test framework'. Besides the development of vocabularies for individual test attributes such as aroma and texture, etc., it is also possible to develop a vocabulary for all of the test attributes of a product/product category. Integrating existing specialist vocabularies from the literature (e.g. DLG Sensory Analysis Vocabulary, etc.) may possibly speed up and simplify the process of collecting descriptive terms in the first step. Corresponding, possible exercises are described in the training plan (Annex D) using the example of dark chocolate. These are to be regarded as examples and require adaptation to the specific company in each case.

Example training plan, see Annex D, Table: 3.2.2-2

B: Discrimination of intensity levels and scale training (quantitative part: intensity scaling)

Following the preliminary completion of the list of descriptors and definitions, the selected assessors must be trained in assessing intensities and using scales. It is important for the subsequent performance of the sensory panel as a valid measuring instrument that the sensory panel members take on board a comparable rating standard during the training and are therefore at least able to rank the intensities of the descriptors for the individual products in an extensively consistent order and to reliably reproduce their ratings. In this process, the reproducibility of their own ratings is more important than the numerical match of the ratings between the sensory panel members. While this training objective is sufficient for relative scaling, i.e. comparative intensity ratings that are usually the norm when conducting QDA® type profile analyses, more intensive training is needed in the case of absolute scaling according to the Spectrum™ method (a valid profile of an individual product is to be created without the intention of a comparison). In this case, the sensory panel members must be trained to deliver exactly the same intensity ratings. Whether category or unstructured linear scales are used for intensity rating is of secondary importance. What is crucial is that the scope of the scale is sufficient to illustrate the differences between the intensities of an attribute for various products, but is not so extensive that it overstrains the sensory assessors' ability to differentiate.

After this training block, the panel leader must evaluate the sensory assessors' performance according to the previously defined performance criteria (minimum requirements for the performance of the sensory assessors as regards use of scales and discrimination between intensity levels). The sensory assessors can only complete the next training unit or the actual profile test, if the requirements desired for the subsequent testing work are met. Appropriate software programmes (e.g. free PanelCheck software) can be used to facilitate data evaluation.

Example training plan, see Annex D, Table: 3.2.2-3

C: Pilot phase and test measurements (initial sensory profiling)

The sensory assessors who are trained in terms of descriptors and intensity measurements are now familiarised with the real test conditions in a pilot phase and conduct initial profile tests. A further reduction of the list of descriptors and definitions is possible and sensible during this so-called pilot measurement (see 'Praxishandbuch Sensorik in der Produktentwicklung und Qualitätssicherung', Behr's Verlag GmbH, Chapter 2.1, C. Rummel). Attributes that are not used by the sensory panel members (attention: these could be needed for subsequent samples under certain circumstances!), descriptors that do not show any differences in the tested samples (i.e. they are not discriminatory with respect to the analysis problem) and descriptors that outline the contrasting characteristic of another attribute (e.g. hard/soft) can be deleted.

Example training plan, see Annex D, Table: 3.2.2-4

D: Check of sensory assessor and panel performance (ability to discriminate, repeatability and reproducibility)

Prior to the start of routine profiling, the performance and reliability of the sensory panel as a 'measuring instrument' must be checked and evaluated based on the previously defined minimum requirements for the sensory assessors and panel (see DIN EN ISO 11132). This monitoring is important, since it involves an analytical test comparable to an instrument-based measurement and the individual test results should be correct and equivalent. It must be ensured that the sensory assessors' performance is reproducible and that they do not deliver contradictory results, at least amongst themselves, as regards the attribute description and the intensity ranking (i.e. all sensory assessors must at least deliver the same intensity ranking). With regard to the sensory assessors and potential sensory panel members as well as the panel as a whole (reliability) the check of adherence to the previously defined performance criteria by the panel leader following the pilot phase is crucial to sensory assessor selection/the sensory panel composition and therefore to the performance and reliability of the sensory panel in the respective project. Appropriate software programmes can be used to facilitate data evaluation.

Example training plan, see Annex D, Table: 3.2.2-5

3.3.3 (Minimum) requirements for establishing sensory quality assurance

With the exception of the descriptive sensory panel training course, the above described training plans meet the requirements of DIN EN ISO 8586. However, they are relatively comprehensive and cover a broad spectrum of sensory methods.

The resources available in many production companies are limited. This refers to time and personnel, i.e. ultimately finances, as well as facilities. The objective of all food-producing companies is to establish good sensory quality assurance, whereby discrimination tests are primarily used. The people who undertake sensory analysis tasks and are responsible for their results are usually incumbents. These are usually employees from the quality management and quality assurance departments, from research & development or the production department, although the latter are not actually the most suitable candidates for such testing activities due to their insider knowledge of analysis results or internal production information. Depending on the size of company, costly selection procedures for sensory assessors and panel members are therefore usually unnecessary. Focus here is placed on the qualification of a discriminatory sensory panel. Above all, this involves training sensory fundamentals and checking personal sensory suitability, training sensory perceptions and memorising the sensory descriptors and profiles of the products manufactured within the company so that quality fluctuations and deviations from the defined, optimum sensory quality standard (sensory product specifications), what is called the 'gold standard', can be reliably recognised by the sensory assessors and panel members. According to the information in DIN 10973:2013-06, the IN/OUT test can be performed with at least three sensory assessors.

Contrary to the conditions commonly found in practice, however, the authors would additionally like to note that it is also necessary to have as many sensory assessors as possible available, particularly in sensory quality assurance. If sensory quality deviations have to be reliably identified, confirmed or also invalidated by means of suitable discrimination methods (triangle test or similar), a discriminatory sensory panel should ideally have a minimum size of $n = 25-30$. In order to compensate for staff shortages and to meet the requirements defined in the DIN EN ISO standards for performing a number of

discrimination tests, the pool of trained sensory assessors should ideally be twice this number. In principle, planning and work can also be carried out using several sample sets and test cycles in order to compensate for staff shortages and to achieve the statistically required number of test results. However, this approach is error-prone from a statistical point of view, although nobody knows the precise extent of this error.

The following design of a sensory assessor training course is focussed on the tasks and describes the minimum requirements that are to be made on the establishment of sensory quality assurance and that comply both with the specifications of DIN EN ISO 8586 and with the requirements of the common food safety standards. Once again, the foods used in the tests were selected as examples and can be exchanged with others as required.

Example training plan, see Annex E, Table: 3.3.3-1

4. Conclusion

In addition to the modules from the standard that are described in DLG Expert report 7/2017 'Practice guide for sensory panel training, Part 1: Requirements in accordance with DIN EN ISO 8586:2014-05', the objective of this publication is to present examples of possible training plans from the point of view of various target groups or with reference to specific sensory methods. Practitioners such as panel leaders and project managers in product development and quality assurance within the food industry or other sectors in which sensory analyses are implemented are presented with various ideas and options for compiling training concepts thanks to the modular structure that is also selected here. The authors' intention is therefore to provide practicing users of sensory analyses with professional support in implementing the DIN EN ISO 8586 training standard as well as with suggestions for creating their own training concepts. We would be delighted to receive positive feedback as well as constructive criticism.

5. Overview of relevant standards and literature references

- DIN EN ISO 5492:2008-10 – Sensory analysis – Vocabulary
- DIN EN ISO 8586:2014-05 – Sensory analysis – General guidelines for the selection, training and monitoring of selected assessors and expert sensory assessors
- DIN EN ISO 8589:2014-10 – Sensory analysis – General guidance for the design of test rooms
- DIN EN ISO 4120:2009-08 – Sensory analysis – Methodology – Triangle test
- DIN EN ISO 5495:2016-10 – Sensory analysis – Methodology – Paired comparison test
- DIN ISO 8587:2010-08 – Sensory analysis – Methodology – Ranking
- DIN ISO 3972:2013-12 – Sensory analysis – Methodology – Method of investigating sensitivity of taste
- DIN EN ISO 10399:2010-06 – Sensory analysis – Methodology – Duo-trio test
- DIN EN ISO 13299:2016 – Sensory analysis – Methodology – General guidance for establishing a sensory profile (ISO 13299:2016)
- DIN EN ISO 11132:2017-10 – Sensory analysis – Methodology – Guidelines for monitoring the performance of a quantitative sensory panel (ISO 11132:2012)
- Busch-Stockfisch, Mechthild, Praxishandbuch Sensorik in der Produktentwicklung und Qualitätssicherung, B. Behr's Verlag GmbH & Co. KG, Hamburg
- Derndorfer, Eva, Lebensmittel-Sensorik, 5th Edition 2016, Facultas Verlags- und Buchhandels AG, Vienna, Austria
- DLG Sensory Analysis Vocabulary, DLG Sensory Analysis Committee, DLG-Verlag GmbH, Frankfurt/M., 2015
- DLG Expert Knowledge Series - Sensory Analysis, free to download from http://www.dlg.org/expertenwissen_sensorik.html

Selection of possible software programmes for data collection and evaluation:

Data collection and, in part, also evaluation:

- FIZZ Software: <https://www.biosystemes.com/en/fizz-software.php> (05.02.2018)
- EyeQuestion Sensory Software: <https://eyequestion.nl/> (23.04.2018)
- Red Jade Sensory Software: <http://redjade.net/> (23.04.2018)
- Compusense: <https://www.compusense.com/en/software/> (05.02.2018)

Evaluation:

- XLSTAT: <https://www.xlstat.com/de/loesungen/sensory> (05.02.2018)
- PanelCHECK: <http://www.panelcheck.com/> (05.02.2018)

Annex A

Basic training in the Bachelor study programme

Preliminary selection of sensory assessors

Table 3.1.1-1 Preliminary selection of sensory assessors, Bachelor study programme training unit 1 (T 1)

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Recognition of taste blindness	Matching test	Presentation of all 'taste types' for familiarisation and initial allocation; 1 tray with 7 test solutions per sensory assessor plus 1 tray with 12 test solutions in these concentrations (metallic and salty 1x only, all others 2x)	DIN EN ISO 8586 p. 14/15 Tab. 3	2
Recognition of odour blindness	Matching test	As for taste, 4 odour samples per sensory assessor for familiarisation plus 9 samples (2 each identical, 3x lemon) for allocation	DIN EN ISO 8586 p. 14/15 Tab. 3	2
Colour recognition	Colour series ranking test	2 colour series (yellow to blue and red to blue)	DIN EN ISO 8586 p. 13/14 Tab. 1	1
Recognition of visual differences in intensity (grey scales)	Concentration series ranking test (solid medium)	Starch/graphite mixtures	DIN EN ISO 8586 p. 13/14 Tab. 2	1

Training of selected sensory assessors

Table 3.1.1-2 Training of selected sensory assessors, Bachelor study programme training unit 2 (T 2)

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Taste recognition, basic taste	Recognition test	sour: 0.28 g/l bitter: 0.2 g/l salty: 1.2 g/l sweet: 6.0 g/l umami: 0.3 g/l metallic: 0.004 g/l astringent: 0.5 g/l 10 samples (if necessary to start off, initially 2x each sweet, bitter, sour, salty, umami)	DIN EN ISO 8586 p. 21/22 Concentrations (rounded) DIN ISO 3972, p. 9, Tab. 3	7
Discrimination of intensity levels (basic taste)	Ranking test	sweet: Concentrations 4/6/8/12 g/l (disorderly sequence on the sample trays, e.g. 4/12/8/6 g/l)	DIN EN ISO 8586 p. 21/22 Tab. 9, p. 17/18 Tab. 4	4
Stimulus threshold (basic taste)	Triangle test	salty in the concentrations 1.3/0/0 g/l, one sample set per sensory assessor, balanced arrangement across the group according to AAB/ABA/BAA (B = 1.3 g/l); as for bitter in the concentrations 0.2/0/0 g/l (B=0.2 g/l)	DIN EN ISO 8586 p. 17 Tab. 4	3
Colour recognition (see T 1)	Colour series ranking test	2 colour series (yellow to blue and red to blue)	DIN EN ISO 8586 p. 13/14 Tab. 1	1
Recognition of visual differences in intensity (grey scales) (see T 1)	Concentration series ranking test (solid medium)	starch/graphite mixtures	DIN EN ISO 8586 p. 13/14 Tab. 2	1
Odour recognition	Association test, odour description/ designation for the substance	7 odours (procedure as in previous DIN 10961)	DIN EN ISO 8586 p. 18-20 Tab. 6	5

Table 3.1.1-3 Training of selected sensory assessors, Bachelor study programme training unit 3 (T 3)

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Taste recognition, basic taste (see T 2)	Recognition test	sour: 0.28 g/l bitter: 0.2 g/l salty: 1.2 g/l sweet: 6.0 g/l umami: 0.3 g/l metallic: 0.004 g/l astringent: 0.5 g/l 10 samples (2x each sweet, bitter, salty, 1x sour, 1x umami plus 1x each metallic and astringent)	DIN EN ISO 8586 p. 21/22 Concentrations (rounded) DIN ISO 3972 p. 9, Tab. 3	7
Discrimination of intensity levels (basic taste) (as in T 2)	Ranking test	salty: 1.0/1.3/1.6/2.0 g/l	DIN EN ISO 8586 p. 21/22, Tab. 9, p. 17/18, Tab. 4	4
Stimulus threshold (basic taste) (as in T 2)	Triangle test	sweet: 6/0/0 g/l sour: 0.2/0/0 g/l	DIN EN ISO 8586 p. 17, Tab. 4	3
Discrimination of intensity levels (odour)	Ranking test	Isoamyl acetate	DIN EN ISO 8586 p. 17/18, Tab. 5	4

Table 3.1.1-4 Training of selected sensory assessors, Bachelor study programme training unit 4 (T 4)

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Taste recognition (as in T 2, but with modified sample composition)	Recognition test	sour: 0.28 g/l bitter: 0.2 g/l salty: 1.2 g/l sweet: 6.0 g/l umami: 0.3 g/l metallic: 0.004 g/l astringent: 0.5 g/l 10 samples (modified composition)	DIN EN ISO 8586 p. 21/22 Concentrations (rounded) DIN ISO 3972, p. 9, Tab. 3	7
Discrimination of intensity levels (basic taste) (as in T 2)	Ranking test	sour: 0.1/0.2/0.3/0.5 g/l	DIN EN ISO 8586 p. 17/18 Tab. 5	4
Stimulus threshold (basic taste) (as in T 2)	Triangle test	umami: 0.3/0/0 g/l metallic: 0.005/0/0 g/l	DIN EN ISO 8586 p. 17, Tab. 4	3
Colour recognition (see T 1)	Colour series ranking test	2 colour series (yellow to blue and red to blue)	DIN EN ISO 8586 p. 13/14, Tab. 1	1
Recognition of visual differences in intensity (grey scales) (see T 1)	Concentration series ranking test (solid medium)	starch/graphite mixtures	DIN EN ISO 8586 p. 13/14, Tab. 2	1
Recognition of differences in texture	Ranking test	gelatine samples	DIN EN ISO 8586 p. 21, Tab. 8	6
Odour recognition (as in T 2)	Association test, odour description/designation for the substance	7 odours (procedure as in previous DIN 10961)	DIN EN ISO 8586 p. 18-20, Tab. 6	5

Table 3.1.1-5 Training of selected sensory assessors, Bachelor study programme training unit 5 (T 5)

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Taste recognition (as in T 2, but with modified sample composition)	Recognition test	sour: 0.28 g/l bitter: 0.2 g/l salty: 1.2 g/l sweet: 6.0 g/l metallic: 0.004 g/l umami: 0.3 g/l astringent: 0.5 g/l 10 samples (modified composition)	DIN EN ISO 8586 p. 21/22 Concentrations (rounded) DIN ISO 3972, p. 9, Tab. 3	7
Discrimination of intensity levels (basic taste) (as in T 2)	Ranking test	bitter : 0.1/0.2/0.3/0.5 g/l	DIN EN ISO 8586 p. 17/18 Tab. 5	4
Stimulus threshold (basic taste)	Triangle test	salty : 1.3/1.3/0 g/l; balanced arrangement according to BBA/BAB/ABB (B = 1.3 g/l) As for bitter : 0.2/0.2/0 g/l (B=0.2 g/l)	DIN EN ISO 8586, p. 17, Tab. 4	3
Discrimination of aroma perception, retronasal vs. orthonasal	Von Skramlik test Sugar/cinnamon test Aroma recognition when smelling and tasting	With orange oil (hold the bottle in front of the open mouth; breathe in and out calmly with the nose held closed, then release the nose) One beaker of sugar (1.) or cinnamon/sugar (2.); taste each (blind) with and without the nose held closed apricot or peach nectar; aroma description after smelling the sample (orthonasal) and after tasting the sample (retronasal)		
Colour recognition (see T 1)	Colour series ranking test	red to blue and yellow to blue	DIN EN ISO 8586, p. 13/14, Tab. 1	1
Recognition of visual differences in intensity (colour)	Colour intensity series ranking test	red, orange, green	In accordance with previous DIN 10961	1
Odour recognition	Association test, odour description/designation for the substance	aniseed, cinnamon, thyme, sage, rosemary, clove (possibly as dry product)	DIN EN ISO 8586 p. 18-20 Tab. 6, 7	5

Table 3.1.1-6 Training of selected sensory assessors, Bachelor study programme training unit 6 (T 6)

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Recognition of trigeminal stimuli	Recognition test	ginger (hot), menthol (cooling), coconut fat (cooling), chili (pain), classic mineral water (tingling)		
Texture description	Simple descriptive test	carrots, radishes or kohlrabi (crunchy, firm to the bite) pears with lemon (juicy, possibly gritty or soft) full-fat cream cheese (creamy) semolina or couscous (grainy, gritty) gummy animals (elastic, rubbery) marshmallow (tough) cream toffee (sticky, tough or brittle) crisps, peanut flips (crunchy)	DIN EN ISO 8586 p. 19/20 Tab. 7	5
Recognition of differences in texture (foods)	Ranking test	Various chocolate desserts of varying firmness (e.g. cooked pudding, instant pudding, mousse au chocolat, chocolate cream)		10
Recognition of visual differences in intensity (grey scales) (see T 1)	Concentration series ranking test (solid medium)	starch/graphite mixtures	DIN EN ISO 8586 p. 13/14 Tab. 2	1

Table 3.1.1-7 Training of selected sensory assessors, Bachelor study programme training unit 7 (T 7)

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Stimulus threshold (basic taste) (as in T 5)	Triangle test	sweet: 6/6/0 g/l sour: 0.2/0.2/0 g/l	DIN EN ISO 8586, p. 17, Tab. 4	3
Recognition of differences in intensity (basic taste in the food); discrimination test methodology training	Paired comparison test	salty: Tomato juice with or without the addition of extra salt		10
Recognition of differences in intensity (basic taste in the food); discrimination test methodology training	Triangle test	orange juice (without fruit pulp) with the addition of different quantities of sugar or citric acid		10
Colour recognition (see T 1)	Colour series ranking test	red to blue and yellow to blue	DIN EN ISO 8586 p. 13/14 Tab. 1	1
Recognition of visual differences in intensity (colour)	Colour intensity series ranking test	red, orange, green	In accordance with previous DIN 10961	1
Odour recognition	Association test, odour description/ designation for the substance	benzaldehyde, cinnamaldehyde, anethol, vanillin, coconut, isoamyl acetate, eugenol, aniseed, thymol, menthol, camphor, eucalyptus, caraway, clove	DIN EN ISO 8586, p. 20, Tab. 6 p. 22, Tab. 9	5

Table 3.1.1-8 Training of selected sensory assessors, Bachelor study programme training unit 8 (T 8)

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Taste recognition, basic taste (see T 2) (change composition of the samples)	Recognition test	sour: 0.28 g/l bitter: 0.2 g/l salty: 1.2 g/l sweet: 6.0 g/l metallic: 0.004 g/l umami: 0.3 g/l astringent: 0.5 g/l 10 samples (modified sample composition)	DIN EN ISO 8586 p. 21/22 Concentrations (rounded) DIN ISO 3972, p. 9, Tab. 3	7
Discrimination of intensity levels (basic taste) (as in T 2)	Ranking test	sweet: 4/6/8/12 g/l	DIN EN ISO 8586 p. 17/18 Tab. 5	4
Stimulus threshold (basic taste) (as in T 5)	Triangle test	umami: 0.3/0.3/0 g/l metallic: 0.005/0.005/0 g/l	DIN EN ISO 8586, p. 17, Tab. 4	3
Hedonics/preference methodology training	Paired preference test (hedonic variant of the paired comparison test)	small chocolate figures of identical appearance from 2 manufacturers		10
Recognition of differences in intensity (basic taste in the food); discrimination test methodology training	Duo-trio test	apple juice with or without the addition of extra sugar		10
Scale methodology training	Acceptance test (hedonic 9-point scale)	4 different types of cream cheese with herbs		10
Odour recognition	Association test, odour description/designation for the substance	menthol, eucalyptus, camphor, grass, mushroom, lemon, vanilla, aniseed, cinnamon, thyme, sage, rosemary, clove (the latter possibly as dry product)	DIN EN ISO 8586, p. 20, Tab. 6	5

Table 3.1.1-9 Training of selected sensory assessors, Bachelor study programme training unit 9 (T 9)

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Discrimination of intensity levels (basic taste) (as in T 2)	Ranking test	sour: 0.1/0.2/0.3/0.5 g/l salty: 1.0/1.3/1.6/2.0 g/l	DIN EN ISO 8586 p. 17/18 Tab. 4, 5	4
Descriptive test methodology training	Simple descriptive test	pralines with fondant filling (solid product) or amarula liqueur (liquid)		10
Scale methodology training	Intensity test/profile analysis (basic scaling methodology)	2 types of whole milk chocolate		10
Recognition of visual differences in intensity (grey scales) (see T 1)	Concentration series ranking test (solid medium)	starch/graphite mixtures	DIN EN ISO 8586, p. 13/14, Tab. 2	1
Recognition of visual differences in intensity (colour)	Colour intensity series ranking test	red, orange, green	In accordance with previous DIN 10961	1
Recognition of differences in texture	Ranking test	gelatine samples	DIN EN ISO 8586, p. 21, Tab. 8	6

Table 3.1.1-10 Training of selected sensory assessors, Bachelor study programme training unit 10 (T 10)

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Taste recognition, basic taste (see T 2) (change composition of the samples)	Recognition test	sour: 0.28 g/l bitter: 0.2 g/l salty: 1.2 g/l sweet: 6.0 g/l umami: 0.3 g/l metallic: 0.004 g/l astringent: 0.5 g/l 10 samples (varying composition)	DIN EN ISO 8586 p. 21/22 Concentrations (rounded) DIN ISO 3972, p. 9, Tab. 3	7
Discrimination of intensity levels (basic taste) (as in T 2)	Ranking test	bitter: 0.1/0.2/0.3/0.5 g/l	DIN EN ISO 8586, p. 17/18, Tab. 5	4
Stimulus threshold (basic taste) (as in T 5)	Triangle test	sweet: 6/6/0 g/l sour: 0.2/0.2/0 g/l	DIN EN ISO 8586, p. 17, Tab. 4	3
Scale methodology training	Descriptive test quality rating (DLG methodology)	orange juice (3 products, 1 of which for a joint warm-up)		10

Final test

Table 3.1.1-11 Final test, Bachelor study programme training unit 11 (T 11)

Objective	Method	Implementation	Minimum requirement
Taste recognition, basic taste (module 7)	Recognition test	Concentrations (rounded) in accordance with DIN EN ISO 3972, p. 9, Tab. 3: sour: 0.28 g/l bitter: 0.2 g/l salty: 1.2 g/l sweet: 6.0 g/l metallic: 0.004 g/l umami: 0.3 g/l astringent: 0.5 g/l 10 samples	At least 8 out of 10 samples must be recognised correctly
Discrimination of intensity levels (basic taste) (module 4)	Ranking test	sour , in accordance with DIN EN ISO 8586, p. 18, Tab. 5	All samples must be correctly classified
Stimulus threshold (basic taste) (module 3)	Triangle test	Concentrations in accordance with DIN EN ISO 8586, p. 17, Tab. 4 (variant AAB, BAA, ABA with B as the sample containing the flavouring), for sweet, bitter, sour, salty	2 types of taste per sensory assessor; both must be recognised correctly
Colour recognition (module 1)	Colour series ranking test	2 colour series (yellow to blue and red to blue) in accordance with DIN EN ISO 8586, p. 13, Tab. 1	2 errors pertaining to 2 neighbouring samples are permissible in each test series with 11 samples
Recognition of visual differences in intensity (grey scales) (module 1)	Concentration series ranking test (solid medium)	starch/graphite mixture, see DIN EN ISO 8586, p.14, Tab. 2	2 errors pertaining to 2 neighbouring samples are permissible in each test series with 10 samples
Recognition of differences in texture (module 6)	Ranking test	gelatine samples in accordance with DIN EN ISO 8586, p. 21, Tab. 8	At least 80% of the samples must be ranked in the correct sequence
Odour recognition (module 5)	Association test, odour description/ designation for the substance	7 odours (including the 4 from DIN EN ISO 8586 p. 15, Tab. 3)	2 errors are permissible with 7 samples

Annex B

Advanced training in the Master study programme

Training of selected sensory assessors

Table 3.1.2-1 Training of selected sensory assessors, Master study programme training unit 2

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Discrimination test methodology training	Paired comparison test (I) Same-different test (II) (test for difference)	tomato juice (A) or tomato juice with the addition of 2 g table salt per litre of juice (B), 30 ml per sample; (I) 1 sample pair per sensory assessor (balance out AB or BA over the group); (II) 1 sample pair 1 sample pair per sensory assessor (balance out AA, BB, AB, BA over the group); half of the group starts with (I), the other half with (II), then switch	DIN EN ISO 5495	10
Discrimination test methodology training	Triangle test (test for similarity)	2 samples of natural yoghurt (same type, different date of manufacture), 40 ml per sample; 2 triple samples per sensory assessor in succession (2 trays, 2 reports), balancing out all 6 sample combinations (AAB, ABA, BAA, BBA, BAB, ABB) over the group and randomly assigning them in groups of 6	DIN EN ISO 4120	10
Discrimination test methodology training	3-AFC test (test for difference; focussed test: the sample with the higher concentration in the triple must be named)	orange juice or orange juice diluted with 80 ml water per litre of juice, 40 ml per sample; 1 triple sample per sensory assessor, balance out 3 sample combinations (AAB, ABA, BAA with B as the more concentrated sample) over the group; mask any visual differences using coloured light or by dimming the light		10

Table 3.1.2-2 Training of selected sensory assessors, Master study programme training unit 3

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Discrimination test methodology training	Duo-trio test (test for difference) with constant reference (I) (duo-trio-middle variant) with balanced reference (II)	apple juice, neat or with 80 ml apple fruit juice drink per litre of juice (alternatively: sweeten 1 sample); 40 ml per sample 1 sample set per sensory assessor consisting of reference R and sample pair AB, positioning the reference sample in the middle (randomly allocate A R B or B R A per half group) One reference sample R (separately, is tasted first) and one sample pair AB per sensory assessor; R=A or R=B per half group, with sample pair half AB or BA in each case, i.e. 4 sample combinations (A/AB, A/BA, B/AB, B/BA) must be balanced out over the group and allocated randomly to the sensory assessors; half of group starts with (I), the other half with (II); the following test (see below) is then completed, then switch	DIN EN ISO 10399	10
Discrimination test methodology training	‚A‘ or ‚not A‘ test	Provide two externally identical and otherwise fairly similar foods (e.g. UHT milk/ESL milk with the same fat content or 2 still mineral waters); provide 1 reference sample A (50 ml) per sensory assessor for memorisation, then remove and subsequently provide 6 samples (consisting of ‚A‘ and ‚not A‘ in a random sequence decided on by tossing a coin for each sensory assessor) (30 ml each)	DIN 10972	10

Table 3.1.2-3 Training of selected sensory assessors, Master study programme training unit 4

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Hedonics/preference methodology training	Paired preference test (hedonic variant of the paired comparison test)	crispbread, 2 comparable samples from 2 different manufacturers (e.g. Wasa and Burger) or 2 types from one manufacturer; 1 sample pair per sensory assessor (½-1 piece each) in a balanced arrangement (AB or BA) on a tray.	DIN EN ISO 5495	10
Creation of sensory profiles methodology training 1 st part: qualitative (preparation of the attribute list)* *Normally requires several sessions	Simple descriptive test	As many different varieties of natural yoghurt as possible: different manufacturers and fat contents, organic/non-organic, set/stirred, fresh/stored (in order to find all relevant attributes: approx. 10-12 samples); each sensory assessor must be able to test all samples (approx. 30 ml each) in order to prepare his/her attribute list; then collection of all attributes on a flip-chart and open discussion to reduce the attributes and prepare a joint attribute list	DIN 10964 DIN 10967 DIN EN ISO 13299	9
Creation of intensity rankings methodology training	Ranking test for ‚bitter‘ intensity	4 beers with different bitter taste intensities (e.g. Pilsner Urquell, Warsteiner, Jever, Radeberger); present each sensory assessor with 4 samples (50 ml each) at the same time in a balanced arrangement on a tray	DIN ISO 8587	4

Table 3.1.2-4 Training of selected sensory assessors, Master study programme training unit 5

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
<p>Creation of sensory profiles methodology training 2nd part: quantitative (intensity scaling)*</p> <p>*Normally requires several intensity and scale training sessions</p>	Profile analysis (conventional profile) with unstructured linear scale	2 different types of natural yoghurt (selection based on results from part 1: 2 samples that are as different as possible); present 2 yoghurt samples per sensory assessor (approx. 60 ml each) at the same time in a balanced arrangement (AB, BA) on a tray; parallel testing of the intensities attribute by attribute in direct comparison (relative scaling)	DIN 10967 DIN EN ISO 13299	8 and 10
<p>Quality rating methodology training*</p> <p>*Normally requires extensive product experience and experience of handling the DLG 5-Point Test Scheme®</p>	Descriptive test with integrated rating (DLG method)	2 types of orange juice; present 2 samples of juice per sensory assessor (50 ml each) in succession in a balanced sequence; testing of each sample individually as regards all attributes without comparing the samples with one another (absolute scaling)		10

Table 3.1.2-5 Training of selected sensory assessors, Master study programme training unit 6

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Difference/similarity measurement methodology training	Difference from control test	6 samples: neat orange juice and different orange juice samples modified by diluting with water or various additives (sugar, lemon juice, vanilla aroma)	DIN 10976	10
Hedonics/preference methodology training	Popularity ranking test	4 types of wieners in natural intestine casing (including poultry and 'light' wieners; no canned goods) Present 4 wiener samples (½ each, cold) at the same time in a balanced arrangement on a tray	DIN ISO 8587	10
Quality testing methodology training	Inside/outside test (IN/OUT test) Variant: categorical test	One (good) neat apple juice as a standard and 6 apple juice samples stretched with various quantities of apple fruit juice beverage and/or water (e.g. 0/100/200/300/400/500 ml additive per litre of juice); first present the sensory assessors with the (normally familiar) standard again for memorisation (50 ml), then remove, subsequently present the 6 test samples (40 ml each) in a random sequence that is different for each sensory assessor (balanced or determined by rolling dice)	DIN 10973	10

Table 3.1.2-6 Training of selected sensory assessors, Master study programme training unit 7

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Quality testing methodology training	Inside/outside test (IN/OUT test) variant: scaled test	See categorical inside/outside test (training unit 6)	DIN 10973	10
Hedonics/acceptance methodology training	Acceptance test by means of hedonic 9-point scale (like/dislike scale)	4 types of cream cheese with herbs (various manufacturers); present 4 samples (approx. 30 ml each) in succession in a balanced sequence, absolute scaling (without comparison)		10
Methodology training, determination of the optimum quantity of an added ingredient by means of a hedonic test	Just about right test	6 varieties of raspberry quark (made of quark and frozen raspberries) with the addition of different quantities of sugar; present 6 samples (50 ml each) at the same time in a random test sequence that differs for each sensory assessor (balanced or determined by rolling dice)		10

Table 3.1.2-7 Training of selected sensory assessors, Master study programme training unit 8

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Methodology training, new descriptive methods	Check all that apply (CATA)	2 types of potato crisps; present both samples (approx. 5-10 crisps each) at the same time		10
Methodology training, new descriptive methods	Free multiple sorting	9 types of natural yoghurt (see T 5: profile analysis); present 9 samples (50 ml each) at the same time		10
Methodology training, new descriptive methods	Project mapping (Napping®)	6 types of cola; present 6 samples (50 ml each) at the same time, lay out a large sheet of white paper (usually 60 x 40 cm) at the workplace for sample arrangement as per the test instructions		10

Final test

The performance of the final test in the Master study programme is similar to that described for training unit 11 in the Bachelor study programme in Annex A, Table 3.1.1-11.

Annex C

Basic training in the company

Table: 3.2.1-1 Basic training in the company (training day 1)

Duration*	Training form	Topic or objective (method/implementation)
08:00 – 08:45	Theory	<ul style="list-style-type: none"> • Procedure, prerequisites, application of sensory food tests
09:00 – 10:00	Laboratory exercises (see bachelor training programme, training unit 1)	<ul style="list-style-type: none"> • Recognition of taste blindness (matching test) • Recognition of odour blindness (matching test) • Colour recognition (colour series ranking test) • Recognition of visual differences in intensity (grey scale ranking test)
10:15 – 11:00	Theory	<ul style="list-style-type: none"> • Odour/taste/texture perception
11:15 – 12:15	Laboratory exercises (see bachelor training programme, training units 2, 4, 5)	<ul style="list-style-type: none"> • Discrimination of intensity levels (basic taste ranking test; sweet, sour) • Stimulus threshold (basic taste triangle test; salty, bitter) • Recognition of visual differences in intensity (colour intensity ranking test) • Odour recognition (association test; aromas)
13:00 – 14:30	Laboratory exercises (see bachelor training programme, training units 3, 4, 5)	<ul style="list-style-type: none"> • Discrimination of intensity levels (basic taste ranking test; salty, bitter) • Stimulus threshold (basic taste triangle test; sweet, sour) • Discrimination of intensity levels (odour ranking test; isoamyl acetate) • Discrimination of intensity levels (texture; gelatine samples) • Von Skramlik test, cinnamon/sugar test • Odour recognition (association test; spices)
15:00 – 16:00	Laboratory exercises (test methods with foods)	<ul style="list-style-type: none"> • Paired comparison test as regards cooked taste (UHT milk, ESL milk) • Triangle test (2 types of bread for toasting, cut out) • Duo-trio test (neat apple juice or + 5 g sugar per litre) • Ranking test according to crunchiness (4 types of gherkins) • Paired preference test (2 types of whole milk chocolate)

*Used for rough orientation for the time needed for the individual modules/tasks

Table: 3.2.1-2 Advanced training in the company (training day 2)

Duration*	Training form	Topic or objective (method/implementation)
08:00 – 09:00	Laboratory exercises (see bachelor training programme, training units 1, 2, 3, 4)	<ul style="list-style-type: none"> • Taste recognition (basic taste recognition test) • Discrimination of intensity levels (basic taste ranking test; sweet, salty) • Stimulus threshold (basic taste triangle test; umami, bitter) • Odour recognition (association test; aromas) • Recognition of visual differences in intensity (grey scale ranking test)
09:15 – 10:45	Theory	<ul style="list-style-type: none"> • Sensory test methods
11:00 – 12:30	Laboratory exercises (see bachelor training programme, training units 1, 3, 4, 5)	<ul style="list-style-type: none"> • Discrimination of intensity levels (basic taste ranking test; sour, bitter) • Stimulus threshold (basic taste triangle test; metallic, sweet) • Odour recognition (association test; spices) • Colour recognition (colour series ranking test) • Recognition of visual differences in intensity (colour intensity ranking test) • Discrimination of intensity levels (texture; gelatine samples)
13:30 – 14:30	Laboratory exercises (test methods with foods)	<ul style="list-style-type: none"> • ‚A‘ or ‚not A‘ test (neat tomato juice or with added salt) • Simple descriptive test (normal and reduced-sugar preserve, same flavour) • Ranking test according to popularity (3-4 types of strawberry yoghurt, various manufacturers)
15:00 – 16:00	Laboratory exercises (test methods with foods)	<ul style="list-style-type: none"> • Inside/outside test (apple juice, see master training programme) • Acceptance test with hedonic scale (wieners from 2 manufacturers) • DLG bread test (2 loaves of rye bread from different manufacturers, with one warm-up sample beforehand)

*Used for rough orientation for the time needed for the individual modules/tasks

Table: 3.2.1-3 Product-related training in the company – introduction to the topic (training day 3)

Duration*	Training form	Topic or objective (method/implementation)
09:00 – 10:00	Laboratory exercises	<ul style="list-style-type: none"> • Recognition of the difference between refined and white sugar in an aqueous solution (triangle test: initially only odour/taste under blue light, then repetition with inclusion of the appearance under white light) • Comparison of refined and raw (VHP) sugar in solid state in terms of taste and aroma (test arrangement and performance as in the sugar/cinnamon test, see bachelor training programme, training unit 5) • Comparison of refined sugar, golden sugar, VHP sugar and dark brown soft sugar (ranking according to popularity; sugar types dissolved in Darjeeling tea) • Comparison of refined sugar, white sugar, organic sugar, golden sugar, VHP sugar and dark brown soft sugar in solid state (simple descriptive test regarding appearance and taste/aroma with subsequent discussion)
10:30 – 11:30	Theory	<ul style="list-style-type: none"> • Enjoyment value of foods, sensory perception, sensory tests
11:45 – 12:45	Laboratory exercises	<ul style="list-style-type: none"> • Comparison of the sweetening power of glucose, fructose and sucrose in an aqueous solution (sweetening intensity ranking test) • Comparison of sugar vs. stevia product in drinking yoghurt (popularity ranking test + subsequent justification and description of the differences; • 3 samples: yoghurt with refined sugar as well as with stevia in 2 different quantities) • Comparison of industrially manufactured liquid sugar with internally produced liquid sugar (duo-trio test with constant reference; reference: industrially manufactured product) • Comparison of the sweetening power of sugar solutions of different degrees of inversion (sweetening intensity ranking test)
13:45 – 15:00	Laboratory exercises	<ul style="list-style-type: none"> • Comparison of refined sugar and various brown candy sugars/caramel products as flavouring agents in muffins (popularity ranking test + justification and description of the differences; sugar component in the muffins: refined sugar and 4 different brown candy sugars/caramel products from light to very dark colour) • Comparison of the brown candy sugars/caramel products from the previous test in the form of the pure substances (simple descriptive test regarding appearance and taste/aroma with subsequent discussion) • Comparison of various syrups and molasses (simple descriptive test regarding odour and taste/aroma with subsequent discussion; 3 different samples) • Comparison of various black sweet products (simple descriptive test regarding odour and taste/aroma with subsequent discussion; 3 different samples)

Annex D

Establishment of a descriptive sensory panel

Preliminary selection of sensory assessors

Table: 3.2.2-1 Preliminary selection of sensory assessors, descriptive panel, training unit 1

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Recognition of taste blindness	Matching test	Presentation of all 'taste types' for familiarisation and initial allocation; 1 tray with 7 test solutions per sensory assessor plus 1 tray with 12 test solutions in these concentrations (metallic and salty 1x only, all others 2x)	DIN EN ISO 8586, p. 14/15, Tab. 3	2
Recognition of odour blindness	Matching test	As for taste, 4 odour samples per sensory assessor for familiarisation plus 9 samples (2 each identical, 3x lemon) for allocation	DIN EN ISO 8586, p. 14/15, Tab. 3	2
Colour recognition	Colour series ranking test	2 colour series (yellow to blue and red to blue)	DIN EN ISO 8586, p. 13/14 Tab. 1	1
Recognition of visual differences in intensity (grey scales)	Concentration series ranking test (solid medium)	starch/graphite mixtures	DIN EN ISO 8586, p. 13/14, Tab. 2	1
Recognition of differences in texture	Ranking test	gelatine samples	DIN EN ISO 8586, p. 21, Tab. 8	6
Registration of verbal expressiveness: descriptive test	Simple descriptive test	pralines with fondant filling (solid product) or Amarula liqueur (liquid) alternatively: dark chocolate with a high cocoa content vs. aerated chocolate	DIN 10964: 2014-11	5

Training of selected sensory assessors

Table: 3.2.2-2 Training of sensory assessors, descriptive panel, training unit 2

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
<p>Development of descriptors (preparation of a list of sensory attributes)</p> <p>Focussed on individual or all product attributes [appearance, odour/aroma, (basic) taste, texture/consistency], sensory attributes and definitions should be developed and, if necessary, suitable references should be defined and compiled in a list.</p>	<p>Simple descriptive test</p> <p>Alternatives/additions: association tests, brainstorming, Kelly's repertory grid method (parallel testing and description of 3 samples in each case), etc.</p>	<p>Presentation of a wide range of product samples of one category (e.g. 6-8 types of dark chocolate: various manufacturers, different cocoa contents, organic vs. conventional) for familiarisation with the products and for collecting a variety of sensory descriptors/attributes that are objective and free of hedonic evaluations. Also, proposal of possible references for verifying the descriptors</p> <p>Individual test or group test/discussion moderated by a panel leader. Attributes used to describe a product can be freely selected, supported by published specialist vocabularies if necessary. Reference materials, see DIN EN ISO 8586 or literature or own ideas. Important: selection oriented to scale anchor points (e.g. melting: dark chocolate vs. nougat chocolate)</p>	<p>DIN 10964: 2014-11</p> <p>ISO 11035: 1994-12</p> <p>DIN EN ISO 13299: 2016-09</p>	9
<p>Descriptor selection and reduction of attributes</p> <p>(Preparation of a joint list of attributes)</p>	<p>Group discussion moderated by panel leader</p>	<ul style="list-style-type: none"> - Collection of all attributes, e.g. on a flip-chart and open group discussion - Elimination of hedonic and quantifying attributes and merger of similar attributes (avoidance of redundancy), development of definitions of these and identification of suitable references - Development of a joint group attribute list containing the essential attributes as well as definitions and references; attribute sequence oriented to the sensory perception procedure <p>The number of sessions required for this entire training unit is dependent on the type of products (e.g. only a limited number of products containing alcohol or spicy products can be tested) and on the performance/creativity of the sensory assessors. Depending on method, approx. 2-5 but possibly also >10 sessions.</p>		9

Table: 3.2.2-3 Training of sensory assessors, descriptive panel, training unit 3

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
(Simple) recognition of differences in intensity	Paired comparison test	Selection of 2 product samples each, in which the sensory differences are very clear and specification of attributes from the previously developed list that describe the differences well (e.g. 'bitter' for dark chocolates with various cocoa contents 50% vs. 70%, 75% vs. 85%, etc.) Sensory panel members must name the sample with the more pronounced attribute Performance at least twice	DIN EN ISO 5495: 2016-10	4
Discrimination of intensity levels and creation of intensity rankings for product-relevant sensory attributes of appearance, odour, (basic) taste or texture	Ranking test (e.g. concentration series basic tastes 'sweet', 'bitter') Alternatively, select or specifically produce samples with different intensities of the respective, other attributes ('brown', 'hard', etc.).	Offer of several concentration series of aqueous solutions of basic tastes e.g. simultaneous presentation of aqueous solutions in different concentrations in a balanced arrangement, e.g.: sweet: 4/6/8/12 g/l bitter: 0.1/0.2/0.3/0.5 g/l check of the ranking for correctness Performance per sample/attribute with at least two repetitions Number of sessions depending on the sensory assessors' level of knowledge and ability to discriminate as regards intensities, on the number and difficulty of the attributes and on the type/quality of the selected products, e.g. 2-5	DIN ISO 8587: 2010-08 DIN EN ISO 8586: 2014-05, p. 17/18	4
Scale training	Intensity test	Offer of the samples already tested by means of the ranking test and rating of the intensities of the same sample attributes based on an intensity scale Check of the correctness of the intensity sequence based on the scale values of the individual sensory assessors as well as the reproducibility between the repetitions Number of sessions: see above	DIN EN ISO 13299: 2016 or previous DIN 10967-1-1999	8 and 10

Table: 3.2.2-4 Training of sensory assessors, descriptive panel, training unit 4

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Performance of profile tests in the sense of pilot and test measurements Creation of sensory profiles	Conventional profile with stageless intensity scale/unstructured linear scale or category scale/point scale	Selection of 2 product samples each from the product portfolio to be subsequently tested and in which sensory differences are clear (e.g. dark chocolates with cocoa contents of 50%,70% and 85%). Presentation of samples at the same time, complete profiling using the developed attribute/definition list and the intensity scales. Parallel testing of the intensities attribute by attribute in direct comparison (relative scaling). Performance: repetition at least twice per sample pair, at least 3 sample pairs (depending on product category)	DIN EN ISO 13299: 2016-09	10
Discussion of the individual results and determination of the possible difficulties as regards descriptor comprehension, intensity measurement, etc.	Group discussion	Discussion of the individual results with moderation by the panel leader Questions to be clarified: <ul style="list-style-type: none"> • List of descriptors/terms appropriate? • Terms good for describing the product? • Are there relationships, doubles? • Can the scales be used well? • Do the sensory assessors use the scale ranges uniformly? • Are there extreme ratings or is there extensive concordance in the sensory panel? Identification of problems during the pilot phase, e.g. with attributes, definitions and intensity assessments, and adaptation of the documents and methods. Identification of possible additional training units, poss. in the area of attributes – references or intensity measurement – scale training as well as decision regarding further training sessions and test profiling.		10

Table: 3.2.2-5 Training of sensory assessors, descriptive panel, training unit 5

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
Check of the sensory panel's reliability (are the prepared product profiles reproducible, does the analytical sensory panel work reliably?)	Conventional profile Performance of profile tests as part of a double test measurement	Selection of 2-3 product samples from the product portfolio to be subsequently tested as per a defined sample plan including blinded double samples and performance of a profile test. Repetition of the final test measurement after a defined period of time, poss. 1 week. Analysis of the rating match between samples and blinded double samples as well as between the different sessions.	DIN EN ISO 13299: 2016-09	10

Annex E

**(Minimum) requirements for establishing sensory quality assurance
(discriminatory sensory assessors/panels)**

Table: 3.3.3-1

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
1-2 hours (depending on the participants' prior knowledge)	Theory	Procedure, prerequisites, application of sensory food tests Odour/taste/texture perception		
Subdivision of the exercises over several max. 2-hour sessions, whereby a maximum of 5 exercises should be conducted	Laboratory exercises (see bachelor training programme, training units)	Recognition of taste blindness (matching test) Presentation of all 'taste types' for familiarisation and initial allocation; 1 tray with 7 test solutions per sensory assessor plus 1 tray with 12 test solutions in these concentrations (metallic and salty 1x only, all others 2x)	DIN EN ISO 8586 p. 14/15 Tab. 3	2
		Recognition of odour blindness (matching test) As for taste; 4 odour samples per sensory assessor for familiarisation plus 9 samples (2 of each identical, 3x lemon) for allocation Von Skramlik Test, cinnamon/sugar test	DIN EN ISO 8586 p. 14/15 Tab. 3	2
		Colour recognition (colour series Ranking Test) 2 colour series (yellow to blue and red to blue)	DIN EN ISO 8586 p. 13/14 Tab. 1	1
		Stimulus threshold (basic taste), Triangle Test, salty in the concentrations 1.3/0/0 g/l, one sample set per sensory assessor, balanced arrangement across the group according to AAB/ABA/BAA (B = 1.3 g/l); as for bitter: 0.2/0/0 g/l (B=0.2 g/l) sweet: 6/0/0 g/l sour: 0.2/0/0 g/l umami: 0.3/0/0 g/l metallic: 0.005/0/0 g/l	DIN EN ISO 8586 p. 17 Tab. 4	3
		Recognition of visual differences in intensity (grey scales) Ranking test Concentration series (solid medium) Starch/graphite mixtures	DIN EN ISO 8586 p. 13/14 Tab. 2	1
		Recognition of visual differences in intensity (colour) Ranking Test Colour intensity series, red, orange, green	In accordance with previous DIN 10961	
		Discrimination of intensity levels (basic taste) Ranking Test sweet: Concentrations 4/6/8/12 g/l (disorderly sequence on the sample trays, e.g. 4/12/8/6 g/l) sour: 0.1/0.2/0.3/0.5 g/l bitter: 0.1/0.2/0.3/0.5 g/l salty: 1.0/1.3/1.6/2.0 g/l	DIN EN ISO 8586 p. 17/18 Tab. 4, 5	4

Objective	Method	Implementation	Standard reference	Ref. to modules of Expert report, Part 1
		Odour recognition Association test, odour description/designation for the substance 7 odours (procedure as in previous DIN 10961)	DIN EN ISO 8586 p. 18-20 Tab. 6	5
1-2 hours (depending on the participants' prior knowledge)	Theory	Sensory quality assurance		
1-2 hours (depending on the participants' prior knowledge)	Laboratory exercises (test methods with foods)	IN/OUT Test 1st step: familiarise yourself with the 'gold standard' and your products. Which sensory attributes characterise this product? Describe these attributes. 2nd step: taste the samples presented to you. Assess whether the respective product corresponds to the 'IN' or 'OUT' category. Write a comment if you assess a product as 'OUT'. Note the deviations from the 'gold standard' with reference to the described attributes.	DIN 10973: 2013-06	10
Subdivision of the exercises over several max. 2-hour sessions, whereby a maximum of 4 exercises should be conducted	Laboratory exercises (test methods with foods)	Depending on requirement within the company Paired Comparison Test e.g. as regards cooked taste (UHT milk, ESL milk) Triangle Test (e.g. 2 types of bread for toasting, cut out) Duo-Trio Test (e.g. neat apple juice or + 5 g sugar per litre) Ranking Test according to crunchiness (e.g. 4 types of gherkins) Paired Preference Test (e.g. 2 types of whole milk chocolate)	DIN EN ISO 5495: 2016-10 DIN EN ISO 4120: 2007-10 DIN EN ISO 10399: 2010-06 DIN ISO 8587: 2010-08	10

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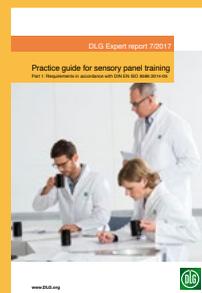
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