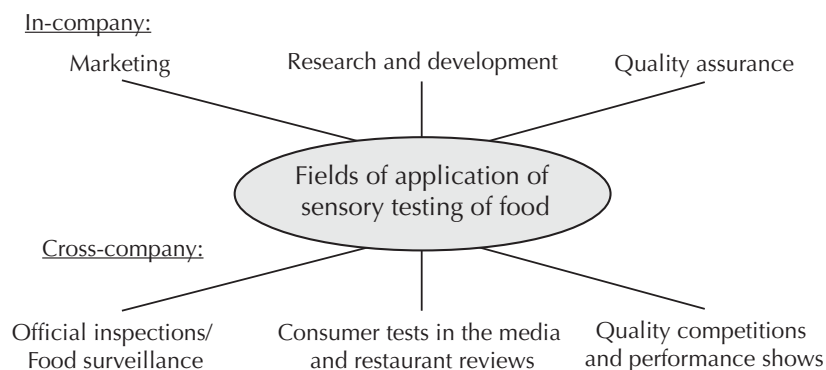


**Sensory analysis:
Overview of methods and fields of
application – DLG-sensory testing**



The fields of application for sensory testing of foods are just as diverse as the sensory methods available. Alongside the in-company applications such as marketing, research and development or quality assurance, sensory methods are also used within the context of cross-company quality competitions and tests (see Fig. 1).

Fig 1: Fields of application for sensory testing of food



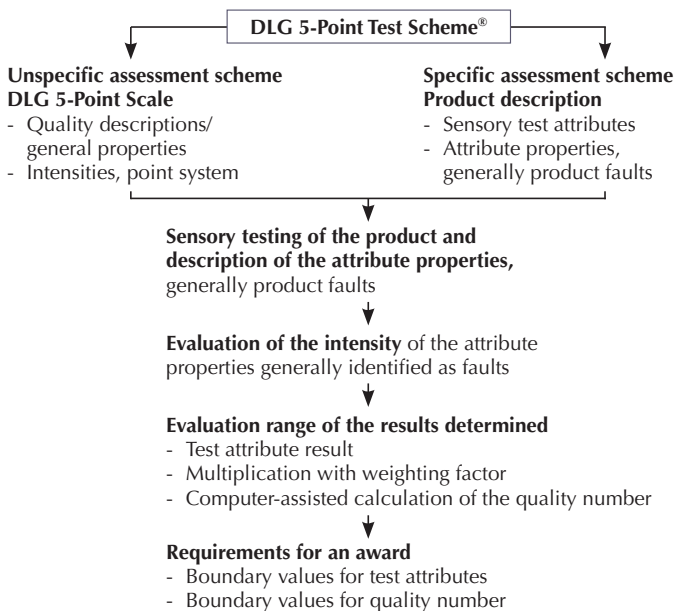
In-company sensory applications focus on examining formulations and production methods for individual products and brands, assuring their individual quality and maintaining their acceptance among defined target groups and markets. Quality competitions and tests, on the other hand, are neutral quality comparisons organised on a cross-company, regional or supra-regional basis. They spur the ambition of participants to gain awards from impartial, expert juries for the particular quality of their products. They thus foster the quality drive in the industry. Accordingly, the DLG quality tests past and present aimed and aim to offer the participating companies an objective, holistic and authentic examination of the enjoyment value with an integrated quality assessment of their products. The testers either confirm freedom from faults of the product submitted or, if any defects are identified, provide the producer with specific tips for improving the quality.

Quality competitions and tests have a long tradition. As the oldest institution of this kind, DLG has been organising quality tests for foods and beverages regularly since 1885. In the sensory analysis by experts (product experts), around which the tests revolve, particular attention is paid to the neutrality and independence of quality assessment. The extensive sensory examinations are supplemented where appropriate by laboratory analyses of further product-specific quality parameters (generally to back up the sensory testing) and by inspection of the preparation, packaging or labelling of the products.

DLG quality tests are open to all producers and are voluntary. Depending on the degree of agreement with the DLG quality criteria, the products submitted are presented with DLG awards in Gold, Silver and Bronze, or if the results are unfavourable, they do not receive any award. The requirements connected with testing and evaluation are prescribed by the DLG Certification Unit. This is accredited in accordance with the international norms DIN EN 45011 and DIN EN ISO/IEC 17024.

The objective of the sensory analysis within the scope of the DLG quality tests is to objectively assess the technical freedom from faults of the food submitted in accordance with Good Manufacturing Practice and the prevailing commercial opinion. The DLG test findings are expert opinions that provide information about product faults caused by the manufacturer due to unsuitable formulations (“wrong model policy”) or production faults (raw material quality, unprofessional technology etc.). Consequently, DLG tests are not involved in market research and do not represent any popularity test.

Fig. 2: Structure of the DLG 5-Point Test Scheme® and course of product assessment



The DLG 5-Point Test Scheme®

The DLG test method is a “descriptive test with integrated assessment”. It is based on the DIN 10964 “Simple descriptive test”, the DIN 10975 “Expert opinion” and the DIN 10969 “Descriptive analysis with following quality evaluation” standards. DLG’s descriptive sensory analysis is carried out using assessment schemes that have been combined with the

sensory test features and the food-specific product properties (generally negative attributes or faults) in the DLG 5-Point Test Scheme[®]. It is of elementary importance here that trained product experts are deployed. They describe the product and its faults with the aid of the specific DLG assessment table and assess the intensity of the quality defect on the basis of their knowledge and experience, using the unspecific DLG assessment scheme.

Specific assessment scheme/table

The DLG 5-Point Assessment Scheme[®] represents a descriptive, sensory analysis with a scale. The sensory analysis addresses the visual (appearance/exterior), haptic (consistency/texture), olfactory (odour) and gustatory (taste) criteria of the products, that are compiled as sensory test features in the specific assessment scheme. These criteria are to be described and assessed. In DLG's specific assessment schemes, the corresponding attribute properties for describing the product faults, such as e.g. cloudy, gluey, pasty, hard, rancid, rotten, bitter, blood spots, bone splinters etc. are allocated to the above sensory test features. As such a list can seldom be complete, the testers are able to specify fault attributes (known as asterisk concepts such as "over-seasoned in one direction", where the corresponding flavour direction must be specified) or even to enter a suitable term under "other defects".

Unspecific assessment scheme

DLG's unspecific assessment scheme consists of a six-stage assessment scale in which the general properties and quality descriptions are accorded points. These serve to transfer the intensities of the product properties or the faults identified and described beforehand into specific data. The general quality properties and points are allocated in accordance with the following table with its six assessment stages:

Points	Quality description	General property description
5	Very good	No deviation from the quality expectations
4	Good	Slight deviations ¹
3	Satisfactory	Moderate deviations
2	Less satisfactory	Distinct deviations
1	Not satisfactory	Strong deviations ²
0	Inadequate	Not evaluable

1 Milk and dairy products including ice cream: slight faults

2 Wine: wine faults ascertained

Slight deviation (4 points)	Is certainly identified by a panel of experts.
Moderate deviation (3 points)	Is certainly identified by an individual expert and very probably identified by a layperson with product experience.
Distinct deviation (2 points)	Is very probably identified by an average consumer; the expert grades the product as not eligible for an award due to the intensity of the deviation.
Strong deviation (1 point)	Is graded by all testers as not eligible for an award due to the intensity of the deviation.
Not evaluable / inadequate / excluded from test (0 points)	Designates a product that is no longer fit for consumption due to its sensory spoiling or other sensory deviations and is thus no longer fit for marketing under food law.

In the DLG test schemes, i.e. the DLG 5-Point Test Schemes[®], the unspecific assessment portion is joined together with the specific descriptive part, resulting in a valuable instrument that structures the sensory analysis for the testers. In addition, the DLG 5-Point Test Schemes[®] serve as test report and test documentation.

The optimal quality standard, i.e. the current commercial opinion of a fault-free product including its so-called hedonic bandwidth is equivalent to the maximum score of 5.0 points. A product only wins a Gold Medal if it is free of sensory faults and satisfies all further quality parameters. There is no single defined and recorded variety standard (gold standard) for the industry-wide quality comparison such as is known from in-house quality assurance. Instead, the reference parameters contain attribute-specific and variety-specific variation ranges. The reference value, termed hedonic bandwidth, can therefore be defined as an "accurate impression of the commercial opinion regarding the various clusters of sound products of a variety". Consequently, for example in the context of a DLG quality test for confectionery, the various milk chocolate products of the manufacturers Milka, Sarotti or Ritter-Sport offered on the market must remain without objections in the test attribute "bite and chewing impression", despite their different mouth feels, for the graduations from "hard" to "soft" milk chocolate lie within the bandwidth of the commercial opinion on mouth feel and therefore have to apply as desired stand-alone or selection criterion for consumers. Crumbly, sandy or sticky consistency of a milk chocolate, on the other hand, would always be a reason for objection.

Each test feature result is subsequently multiplied by its weighting factor. The total of the weighted assessments for all test features is divided by the sum of all weighting factors. This results in the quality number, which then serves as a basis for the award stage.

Fig. 3: Example of a DLG 5-Point Test Scheme®

Prüfschema für Tiefkühlkost, Fleisch- erzeugnisse und Fleischfertigerichte												AUSWERTUNGSBEREICH Prüfungsergebnisse In jedem Prüfmerkmal müssen mindestens 3 Punkte (ungewichtet) erreicht werden									
5-Punkte-Skala und Bewertungstabelle												DLG-Punkte		Qualitätsnoten							
Punkte	Qualitätsbeschreibung	Allgemeine Eigenschaften										Gewichtungs- Faktoren Punkte**		Gewichtete Bewertung							
5	Sehr gut	Keine Abweichungen von den Qualitätsanforderungen										5		X 1							
4	Gut	Geringfügige Abweichungen										4		X 2							
3	Zufriedenstellend	Leichte Abweichungen										3		X 3							
2	Weniger zufriedenstellend	Deutliche Abweichungen										2		X 4							
1	Nicht zufriedenstellend	Starke Abweichungen										1		X 5							
0	Ungenießbar	Nicht bewertbar										0		-							
1. Äußeres, Beschaffenheit in gefrorenem/nicht zubereit. Zustand														Bewertung		5 4 3 2 1 0		X 1 X 1 =			
Gesamtbild des Inhalts		4	3	2	1	0	4	3	2	1	0	4	3	2	1	0					
6185	zu viel gefüllt	5740	unannehmliches Gesamtmaß*	4	3	2	6203	Parade veraltet	4	3	2	6206	Geruch säuerlich	4	3	2	1	0			
6174	zu wenig gefüllt	2028	Eisbildung	4	3	2	1592	Parade überschlüssig (Abnehm)	4	3	2	6170	sonst. Geruch abweichend**	4	3	2	1	0			
5300	Trennung des Füllgutes unzureichend	1100	Austrandigung	4	3	2	4140	Partionen partiell nicht pan.	4	3	2										
4730	Schreibbild unklar	2710	Gefrierbrand	4	3	2	5495	Füllgut verunreinigt	4	3	2										
		5715	Form unannehmlich	4	3	2															
2. Aussehen, Farbe, Herrichtung in verzehrsfähigem Zustand														Bewertung		5 4 3 2 1 0		X 2 X 4 =			
Fleisch		4	3	2	1	0	4	3	2	1	0	4	3	2	1	0					
2265	Farbe zu blass	6149	zu sehr gedöckelt	4	3	2	1205	Knochenplatte	4	3	2	6701	Sonstige Einlage zu viel	4	3	2	1	0			
5975	zu dunkel	2300	Fl. schlecht herrgerichtet*	4	3	2	3300	Knochenstücken	4	3	2	6708	Sonstige Einlage zu grob	4	3	2	1	0			
2156	Farbe ungleichmäßig	3600	Fleischauswahl mangelhaft*	4	3	2	3063	Hörplattchen (für Würstchen)	4	3	2	6709	Sonstige Einlage Verteilung ungleichmäßig	4	3	2	1	0			
2359	missfarbig**	6140	Maßgebungsfehler zu wenig	4	3	2	4086	Parade/Backzeit schwermüßig, fettig	4	3	2	6993	Zubereitungsempfehlung unbrauchbar	4	3	2	1	0			
2725	grau-grünlich	2290	Fettanteil zu hoch	4	3	2	14087	Parade aufgeteilt, abblösend, septat	4	3	2	6997	Zubereitungsempfehlung fehlerhaft	4	3	2	1	0			
6100	Zerklüftung zu stark	4800	Soeckstücke ungleich	4	3	2	14546	Saftverlust (bei pan. Erz.)	4	3	2	6999	Zubereitungsempfehlungen sollten verbessert werden*	4	3	2	1	0			
6105	Zerklüftung ungenügend	4520	Seitenrand zu hoch	4	3	2	2745	Seiten-/Schwanzrandtief grob	4	3	2	6710	Sonstige Mängel**	4	3	2	1	0			
6110	Zerklüftung ungleichmäßig	6200	Kruste/Oberfläche dick	4	3	2	6200	Kruste/Oberfläche dick	4	3	2	6998	Sonstige Mängel**	4	3	2	1	0			
1756	Bräunung mangelhaft	6200	Kruste/Oberfläche dick	4	3	2	6200	Kruste/Oberfläche dick	4	3	2	6999	Sonstige Mängel**	4	3	2	1	0			
		6278	Kruste/Oberfläche zu dicht	4	3	2	6285	Fleischschicht missfarbig*	4	3	2										
3. Konsistenz														Bewertung		5 4 3 2 1 0		X 2 X 2 =			
Fleisch		4	3	2	1	0	4	3	2	1	0	4	3	2	1	0					
6030	zu weich	4835	stirnho	4	3	2	6088	Parade im Biss zu hart, zäh	4	3	2	6710	Sonstige Mängel**	4	3	2	1	0			
5055	im Biss zu schwammig	6030	zäh	4	3	2	6089	Parade im Biss zu weich, zerfall.	4	3	2	6998	Sonstige Mängel**	4	3	2	1	0			
5895	wässrig	1815	Darm zäh	4	3	2	6177	Parade spröde, klebrig, schlingig	4	3	2										
3400	knorpelig	1820	Darm hart	4	3	2	14443	Soße zu breit	4	3	2	14444	Soße schlecht vermischt	4	3	2	1	0			
2780	gummartig	6100	Zusammenhalt mangelhaft	4	3	2	14460	Soße schleimig	4	3	2	14471	Soße dümpf und muffig	4	3	2	1	0			
6025	zu fest	6160	zerfasert	4	3	2	14471	Soße dümpf und muffig	4	3	2	14472	Soße feurig	4	3	2	1	0			
6040	zu trocken	6310	Teile unzerkautbar	4	3	2															
		6310	Teile unzerkautbar	4	3	2															
4. Geruch														Bewertung		5 4 3 2 1 0		X 1 X 2 =			
Fleisch		4	3	2	1	0	4	3	2	1	0	4	3	2	1	0					
4845	säuerlich	4235	ranzig	4	3	2	14452	Soße zu sauer	4	3	2	6710	Sonstige Mängel**	4	3	2	1	0			
4925	saure	1820	dampf und muffig	4	3	2	14452	Soße zu sauer	4	3	2	6998	Sonstige Mängel**	4	3	2	1	0			
2115	fremdartig**	4840	süßmilchmig	4	3	2	14454	Soße fremdartig*	4	3	2										
1723	charakt. Geruch fehlt*	2380	taulig	4	3	2															
5. Geschmack														Bewertung		5 4 3 2 1 0		X 3 X 5 =			
Fleisch		4	3	2	1	0	4	3	2	1	0	4	3	2	1	0					
6440	salzig	1371	brennend	4	3	2	14451	Soße salzig	4	3	2	6710	Sonstige Mängel**	4	3	2	1	0			
4845	säuerlich	3525	metallisch	4	3	2	14452	Soße zu sauer	4	3	2	6998	Sonstige Mängel**	4	3	2	1	0			
4995	sauer	4400	taugig	4	3	2	14453	Soße zu süß	4	3	2	14471	Soße dümpf und muffig	4	3	2	1	0			
4995	süßlich	4235	ranzig	4	3	2	14454	Soße bitter	4	3	2	14472	Soße feurig	4	3	2	1	0			
1365	bitter	4235	ranzig	4	3	2	14456	Soße/Würzung nicht spezifisch*	4	3	2										
2225	fettig	4860	Speck alt	4	3	2	14457	Soße/Würzung nicht abgestimmt*	4	3	2										
1715	charakterist. Aroma fehlt*	2174	Frische fehlt	4	3	2	14458	Soße/Würzung zu schwach	4	3	2										
6925	Würzung nicht spezifisch*	1900	alt	4	3	2	14459	Soße/Würzung zu stark	4	3	2										
5910	Würzung nicht abgestimmt*	1820	dampf und muffig	4	3	2	14461	Soße mehlig	4	3	2										
5916	Würzung zu schwach	4840	schmelzig	4	3	2	14462	Soße fremdartig*	4	3	2										
5920	Würzung zu stark	2330	taulig	4	3	2	14463	Soße brennend	4	3	2										
2325	Fleischaroma zu gering	4174	Parade nicht spezifisch*	4	3	2	14466	Soße taugig	4	3	2										
2440	Lockenungsmitel schmeckt zu stark vor																				
2115	fremdartig**																				
* Bemerkungen = unbeding. erlösen														Laboruntersuchungen beibringt ☐		Reserveproben beibringt haben vorgelegen ☐ fehlen ☐		** Beilagen *** Beilagen		Erzielter DLG-Preis (Goldener ☐ Silberner ☐ Bronzener ☐ Ohne ☐)	
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Unterschriften:

The DLG test method

With regard to the test method, DLG distinguishes between the following two modifications:

The individual test, above all for dairy products and "liquid" products

A tester group consists of four to ten experts (appraisers) who describe and assess the samples individually and independently of each other. DLG appoints one expert within the group as test group leader/spokesperson. This individual calculates the final assessments of the test features from the individual product assessments of the experts by taking the mean value of all individual assessments. In the event of disagreement, the group leader decides on further action to be taken – an open discussion in the group, or possible renewed testing.

The group test, above all for ham and sausage, bakery and confectionery products and convenience and other "fixed" products

Each product is described and assessed by a panel consisting of at least three testers. This is a consensus test in which the testers discuss their individual test results and – if they are not in agreement from the start – work out a joint result. Directly after testing, the result is entered in a product-specific test scheme table. Generally the groups are made up of two practitioners from the craft trades or industry, a representative from the science/research sector, or a representative from the food surveillance sector. Two tester groups in a product area are supported by a coordinator, the test group leader.

A feature that both methods share is a test time of approx. five to seven minutes for each sample, and approx. eight to twelve minutes for ready dishes. The testers regularly neutralise their senses after each sample, or even while assessing the product, with the help of water, low-aroma and warm tea, or "neutral bread", in order to maintain their optimal, sensory perception capacity. Smoking and coffee disturb sensory perception, so that these are prohibited during testing.

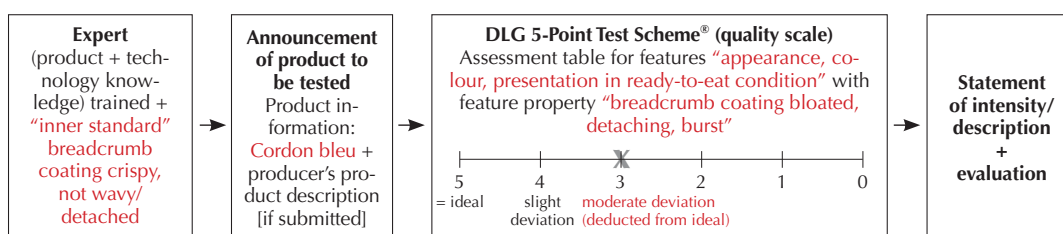
The authorised test officer is responsible for the scientific management of a DLG quality test. In cases of doubt, this officer will take the final decision on assessments in consultation with the test group leader and the testers. Figure 4 shows the general mode of operation for DLG's sensory analysis.

The DLG expert has not only undergone sensory coaching, but also possesses product and technology-related knowledge concerning the product to be tested. The only information testers receive from DLG

Fig. 4: Course of the sensory analysis at DLG

Example of product to be tested: Frozen Cordon bleu

Preparation by DLG in accordance with producer's instructions result in a product with heavily bloated, detaching breadcrumb coating



concerns the stated trade designation (e.g. cordon bleu), and any manufacturer's product description available in neutralised form. Where appropriate, testers are also provided with information about preparation of the product for consumption.

The testers examine the sample submitted at the testing table intensively. This may, for example, be a meat product with moderately bloated, detaching breadcrumb coating. For this the experts use the corresponding DLG 5-Point Test Scheme® with the attribute table specifically compiled for the group of meat products or meat ready dishes and start the sensory analysis by tasting and testing the product with their senses. Testers follow the fixed sensory test attributes and use the product-specific attribute properties (generally product faults) that are listed in the respective assessment tables, select (describe) the appropriate attribute properties, and at the same time specify the intensity of the attribute properties ascertained. The assessment is carried out by comparing the findings with an inner standard on the basis of the expert knowledge available and, where appropriate, supplementing this with the aid of a fixed, written product description or specification submitted by the producer. The "inner standard" is understood to be a representative and current concept of the sensory quality of a food in compliance with good manufacturing practice, acquired chiefly through professional experience. The expert knowledge thus comprises the current commercial opinion regarding a fault-free product, including its hedonic bandwidth. The more complex and multi-layered a food is, e.g. a gateau or a three-component menu, the more problematic it is to specify cross-company standards so that in such cases expert knowledge and product experience become increasingly more important. In the case of cordon bleu with a bloated, detaching breadcrumb coating, the expert will enter the feature attribute or fault "breadcrumb coating bloated, detaching, burst open" in the test feature "appearance, colour, presentation in consumable condition" and assesses this e.g. with "3", in other words as a moderate deviation from the ideal.

After completion of the sensory analysis, the results are evaluated on the basis of given and defined calculation rules. The overall result for the product is obtained by adding the weighted test attribute results, and the final figure represents the basis for the award grade. The evaluation is supplemented – depending on the product sector – by examining the observance of boundary values in accordance with the findings of the laboratory analyses.

On the basis of these results, which are evaluated with computer assistance, the DLG Certification Unit decides on recognition or rejection of certification, i.e. on success of the participation in the test. Where the result is positive, i.e. where the quality criteria defined in the DLG test regulations are satisfied, the food product wins the "DLG award winner" label. Depending on the quality level achieved, a distinction is made between the DLG Awards in Gold, Silver or Bronze.

On receipt of the award, the test findings and a product certificate are sent to the manufacturer.

The DLG testers

At DLG, humans in their capacity as "intelligent measuring instrument" represent the most important factor. This is because humans are the recipients of sensory stimuli and record them by recognising, classifying and storing (memorising) them in their memory. Furthermore, humans can describe their sensory perceptions and evaluate these via their store of experience. As a basis for expert assessment of the foods submitted, DLG manages around 3,000 external specialists working on an honorary basis in a DLG tester pool. For each specific product group, these individuals are invited to participate initially as assistant or guest testers, and subsequently as sensory experts. Given the diversity of sectors from which the experts in the DLG tester pool come, a reliable, product-specific assessment is assured for each quality test. Alongside the sector-specific

connection and pre-qualification, the basic prerequisite consists of coaching in sensory perception and the corresponding application of the DLG 5-Point Test Scheme®. The requirements made of DLG testers/sensory experts are as follows:

- active collaboration as expert/professional in the food sector of a company, an official surveillance facility or a scientific institution
- adequate powers of expression (general language skills, mastery of the product-specific nomenclature),
- medically “fit” (no cold, no allergy/diabetes etc.)
- age (ideal = below the age of 65)
- psychological suitability (objective attitude, good judgement capability, powers of concentration, reliability, ability to work in a team, good “sensory” memory)
- proven sensory skills and technological product knowledge by passing the DLG Qualification Test and obtaining the DLG Tester PassPLUS or comparable status (e.g. official tester)

To summarise, it can be established that the DLG test method can be classified within the framework of sensory analysis as a “descriptive test with integrated evaluation”. It is conducted with neutralised samples by trained experts who are always granted sufficient time for examination. The test result per product results from the sum of individual assessments by 4-10 experts depending on the product sector, which assures a technically objective evaluation. The test reports in the form of the DLG 5-Point Test Scheme® which are developed and permanently updated by sector-specific DLG commissions are structured clearly and standardised. They thus support both the course of the sensory analysis itself and documentation and evaluation of the results. The reports contain the specific descriptions of the tester attributes and attribute properties in the form of possible product faults, and at the same time the scales for assessing fault intensities. The areas of application of the DLG Sensory Method are not only DLG Quality Tests and other performance competitions or consumer tests, but also the in-company areas of quality assurance and control whenever it is important to identify, describe, evaluate and ultimately eliminate product faults. The “Descriptive analysis with quality evaluation” in accordance with the DLG system thus also offers a scientifically appropriate and validated response to many sensory questions and problems encountered in in-house quality assurance.

Further reading on the subject with detailed information includes:

- Geschmackswelten, Prof. Goetz Hildebrandt, DLG-Verlags-GmbH, 2008
- Praxishandbuch Sensorik, Produktentwicklung/Qualitätssicherung, Prof. Mechthild Busch-Stockfisch, Behr’s Verlag GmbH, Hamburg, loose-leaf collection
- Das Konzept der DLG-Leistungswettbewerbe, Deutsche Lebensmittel-Rundschau, issue 10/2000, Prof. Goetz Hildebrandt and Britta Loewe-Stanienda

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