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Odor Profile Descriptive Analysis (OPDA): A new tool for sensory description of complex odors – THEORETICAL ASPECTS –

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4. Options for the application of "classical" methodologies of Descriptive Analysis to describe complex odors

Under the general definition of Descriptive Analysis, its fundamental application is explicitly possible for all human sensory impressions (cf. Lawless/Heymann, 1998, p. 341; Meilgaard et al., 1999, p. 161). The major prerequisite for its successful application is a psychological model that assumes it is possible to categorize a complex perception into individual, independent components, which can then be described by means of an objective, descriptive language (cf. Section 1). In principle, all of the above-described methodologies are based upon this fundamental consideration, with the sole difference consisting of the methodological approach.

The background for the development of the **Flavor Profiling Method** and the **Texture Profiling Method** consisted of the food industry's need for detailed descriptions of the way complex foods are perceived when they are eaten (cf. Lawless/Heymann, 1998, p. 347, p. 356). This overall perception can be categorized into myriad attributes, such as appearance, consistency and taste, as well as odor (op. cit., p. 347). In principle, this also took into account olfactory components of perception. However what would appear to make these two methodologies unsuitable for successful profiling of complex odors are their methodological and application-related limitations. What is problematical is the fact that while the odor of the respective product plays a role in both methodologies, it serves as merely one of many differentiating characteristics. To profile potato chips by means of one of these methodologies, for example, descriptors such as "shape," "salty taste," "crunchiness," "pungent odor," etc. would be conceivable. Thus, including the "pungent odor" descriptor here serves only as one possible criterion for describing the sensory perceptions that are encountered when eating potato chips. And in this case, it also satisfies the purpose according to the definition of Descriptive Analysis: Two samples of potato chips can be successfully described by means of their defined descriptors, while the perception of the "pungent odor" represents an attribute that the panelists consider to play a role (and they are the ones who define the descriptors through consensus).

If, however, products are to be profiled solely on the basis of their odor, then olfactory descriptors suddenly play the leading role. Because in principle, as already discussed above, the objective of this paper is to derive consequences for the application of Descriptive Analysis for profiling products that are perceived exclusively and/or predominantly in an olfactory manner (e.g. cosmetics or cleansing agents). In the case of cosmetics, for example, haptic perception components naturally also play a major role, however the predominant focus of this paper is on the determination of olfactory profiles.

If products are now to be described, and thus compared with and/or differentiated from one another, solely on the basis of their odors, a significantly more detailed view of the olfactory components is required. If samples of potato chips are profiled using 15 gustatory descriptors, multiple, unambiguously descriptive and potentially discriminating (= delimitating) olfactory descriptors should also be defined for samples of shower gels, for example. Only if the descriptors cover all perceivable olfactory stimuli will valid and reproducible results be obtained (cf. Civille/Lawless, 1986, p. 205). This necessitates experts who can perceive and quantify the different olfactory components. In the case of complex odors, however, this task is difficult and even impossible from a certain level onward. What would additionally seem to call into question the successful application of the Flavor Profile Method and the Texture Profile Method is the need to reach a consensus with respect to a product's sensory profile. Odors are perceived individually and tend to be processed emotionally. What is lacking is a suitable vocabulary for verbalization. Consequently, it is unlikely that the panelists will be able to reach the consensus that is necessary in connection with these methodologies.

Quantitative Descriptive Analysis does not require that the panelists reach a consensus, and thus offers the advantage of an individual olfactory product description. Moreover, the intensity

evaluations, which are recorded in the form of quantitative scores, can be statistically analyzed and visualized. This approach produces information that is suitable to the need at hand and relevant to the decision-making process, providing well-founded and swiftly recognizable results, which in principle is desirable in the case of odors, as well. What is problematic, however, is the fact that Quantitative Descriptive Analysis is explicitly based upon intensity scores. The human brain – as discussed above – is incapable of plotting the intensities of a larger number of olfactory descriptors on the 15-cm linear scale containing an essentially infinite number of graduations that is characteristic of this method.

While multiple studies are documented in the literature in which panelists profile products exclusively and/or predominantly on the basis of olfactory descriptors by means of Quantitative Descriptive Analysis (cf. e.g. Lawlor/Delahunty, 2000, pp. 28-29; Martin et al., 2000, pp. 487-495), the above-discussed "intensity problem" calls the validity of these results into question. The first of the two above-mentioned studies describes profiling of 10 cheese samples which involved 9 olfactory descriptors, among other aspects (cf. Lawlor/Delahunty, 2000, p. 30). The second study was of similar design and was intended to sensorially describe 28 microorganisms that occur in cheese. Fourteen olfactory descriptors were employed for this purpose (cf. Martin et al., 2000, p. 489). Martin et al. also confirm the risk inherent in this approach, i.e. highly scattered intensity scores for each descriptor relative to a test product: Within the context of the critical review of their results, they point out that there was very high scatter both within a panel as well as between the scores of the two panels participating in the study (cf. Martin et al., 2000, p. 494).

The promising and scientifically based application of Quantitative Descriptive Analysis must therefore be viewed in a critical light. This situation can also be applied without restriction to **Spectrum Descriptive Analysis**. In addition, under this methodology multiple reference-supported anchors on the horizontal linear scale additionally impede olfactory perception measurement.

For the following reasons, it is not meaningful to use 6 verbal anchors to plot the intensity of the "rose odor" descriptor, for example, on a 10-cm linear scale in order to profile a shower gel: The fact is that it will be very difficult, on the one hand, for the panelists to smell the "rose component" out of the complex olfactory mixture. And, on the other hand, major scatter is likely to be involved in plotting the intensities, as differentiation cannot be made between 6 levels. Moreover, the methodologically anchored standardization of the references in Spectrum Descriptive Analysis must be viewed in a critical light. A trained panelist can undoubtedly compare the hardness of a product with a standardized reference stimulus (e.g. the hardness of a peanut). It would presumably not be meaningful, though, to determine the intensity of the rose odor by mentally comparing it with the intensity of an olfactory reference stimulus. However these so-called reference intensities serve as a core element of Spectrum Descriptive Analysis. Within the framework of the training meetings, the individual graduations of the linear scale are anchored with firmly defined, uniform reference intensities (e.g. "the hardness of a peanut"). It is precisely these anchors that must subsequently be recalled at the profiling meetings. The panelists are thus being asked to make an abstract comparison between product and defined reference intensity – an approach that is hardly likely to be successful in determining olfactory profiles due to the above-discussed peculiarities of olfactory perception.

These considerations are fundamentally applicable to **Free-Choice Profiling** and **Flash Profiling**, as well, as they involve the determination of intensities. Moreover, it should also be noted that if they are to be individually described without any restrictions – as is customary in Free-Choice Profiling – odors, in particular, can result in extremely differing descriptor lists. In Free-Choice Profiling, each panelist uses an individually developed list of descriptors. Subjectively characterized experiences with an odor lead to extremely differing descriptors, which pose considerable challenges with respect to analysis, as the differing vocabulary has to be interpreted in a viable manner (cf. Lawless/Heymann, 1998, p. 369).[2]

[2] In the interpretation, for example, it is necessary to review whether the descriptor "earth" used by Panelist 1 has the same meaning as the descriptor "musty" used by Panelist 2.

These comments show that while, in principle, it is possible to apply the popular methodologies of Descriptive Analysis to olfactory profiling, a one-to-one application of all conceptual and/or methodological aspects of the methodologies would not appear to be very meaningful. Consequently, the following section will present a new approach whose purpose is to take into consideration to the greatest possible extent the above-outlined difficulties in connection with registering olfactory perception.

5. Odor Profile Descriptive Analysis (OPDA)

5.1. Registering product similarities instead of property intensities

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