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Standard Guide for Screening and Training of Assessors and a General Approach for the Sensory Evaluation of Toothpaste Appearance, Flavor, and Texture[1]

This standard is issued under the fixed designation E2978; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide provides guidelines for the selection and training of expert assessors for the sensory evaluation of toothpaste. Sensory evaluation of toothpaste can be used to define the sensory attributes of toothpaste and then to measure these attributes quantitatively for the purposes of new product development, product optimization, competitive benchmarking, and claims substantiation.

1.2 A general framework for toothpaste descriptive analysis is provided to guide the reader in the design and execution (including sample preparation and presentation, facility and testing environment, and specific evaluation protocol) of toothpaste descriptive analysis evaluations.

1.3 This guide provides suggested protocols and approaches to the evaluation of toothpaste (dentifrice) and in no way excludes any alternate approaches that may be effective in providing such perceptual evaluations.

1.4 This guide does not address other oral care products including, but not limited to, whitening agents, oral rinses, mouthwashes, toothbrushes, dental flosses, denture adhesive, floss picks, or other oral care products.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E253 Terminology Relating to Sensory Evaluation of Materials and Products

E1490 Guide for Two Sensory Descriptive Analysis Approaches for Skin Creams and Lotions

E2082 Guide for Descriptive Analysis of Shampoo Performance

3. Terminology

3.1 *Sensory Attributes and Definitions*—Refer to Terminology E253 for common sensory terms that may be applied to the evaluation of toothpaste.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *anise/licorice, n*—aromatics associated with sweet, spicy herbs containing anethole, for example, licorice gum and licorice candy.

3.2.2 *baking soda complex, n*—metallic, salty, mouth coating with radiating burn feeling, including mouth slip, for example, 0.1 % baking soda solution and unflavored seltzer water.

3.2.2.1 *Discussion*—The study designer may choose to separate this complex attribute into more granular attribute measures.

3.2.3 *bicarbonate feeling factor, n*—additionally can be recognized as the chemical feeling factor associated with sodium bicarbonate.

3.2.4 *brown spice, n*—bark, buds, flowers, roots, fruit, and secretions of plants used to create pungency, bite, or character in foods and aromatics associated with a range of earthy, musty, woody, sweet, warm, citrus, terpeney, sassafras, brown spices that can include bitter and numbing, for example, cinnamon, cardamom, clove, mace, coriander, and nutmeg, 0.1 % allspice solution, and strong cinnamon chewing gum.

3.2.5 *chalky feel, n*—textural perception of small particulates.

3.2.6 *chalky flavor, n*—aromatics associated with mineral salts such as chalk along with some cement-like and dusty notes, for example, chalk dust, milk of magnesia, calcium carbonate, and calcium oxide.

3.2.7 *earthy, adj*—aromatic associated with mushrooms, potatoes, and potting soil.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2.8 *foam, n*—characteristics of the bubbles produced during the use of the product and this may specifically include more granular measures such as:

3.2.8.1 *foam amount,*

3.2.8.2 *foam uniformity, and*

3.2.8.3 *denseness of bubbles produced.*

3.2.9 *green (viney), n*—aromatic associated with plants, particularly with plant stems, for example, the aromatic associated with tulip stems.

3.2.10 *gritty, adj*—sensation of coarse, hard particles perceived in the mouth, for example, quick dissolving antacid (calcium carbonate) tablets and granulated sugar.

3.2.11 *menthol, n*—"green" aromatic with associated nasal pungency and cooling feeling factor (and burning at higher levels) while in the mouth, for example, menthol and eucalyptus cough drop and mentholated topical cough suppressant ointment.

3.2.12 *mint complex, n*—sum of the combination of several aromatics associated with mint such as wintergreen, spearmint, and peppermint.

3.2.12.1 *Discussion*—Other attributes associated with mint complex may include basic tastes and feeling factors such as: sweet, bitter, cooling, pungency, and menthol, all of which are rated separately.

3.2.13 *overall impact, n*—sum total of the sensory impressions (sensations) of the sample in the mouth that includes aromatics, basic tastes, and feeling factors.

3.2.14 *peppermint, n*—aromatics associated with peppermint leaves.

3.2.14.1 *Discussion*—Other associated characteristics with peppermint typically include sweet, mint, cooling, green notes, bitter, and pungency, all of which are rated separately. Noncategory examples of peppermint include peppermint gum and candies.

3.2.15 *peroxide, n*—aromatic associated with hydrogen peroxide; can include astringency, soapy, prickly, vinyl impression, soured, and metallic taste and aftertaste, for example, 1:4 dilution hydrogen peroxide.

3.2.16 *pins and needles/numbing/stinging, n*—feeling factor associated with a sharp, stinging sensation that can be intense and includes a decrease or loss of sensation (numbing) often as a result of intense carbonation and a reaction to strong flavoring oil, essence, or extracts, for example, rinsing the oral cavity with hydrogen peroxide and then expectorating.

3.2.17 *slick, adj*—measure of the lack of resistance to tongue movement across the surface of the teeth.

3.2.18 *soapy aromatic, adj*—aromatics associated with lipolyzed milk solids, hydrolyzed vegetable fat, tallow-notes, or hydrolyzed animal fat, or combinations thereof.

3.2.19 *soapy mouthfeel, adj*—alkaline and slippery feel on the soft tissues of the mouth.

3.2.20 *spearmint, n*—aromatics associated with spearmint.

3.2.20.1 *Discussion*—Other associated characteristics with spearmint typically include sweet, bitter, green notes, and cooling (though typically not as intense as peppermint), all of which are rated separately, with slightly less burn than peppermint.

3.2.21 *thymol-eucalyptol, n*—aromatics associated with the aroma of eucalyptus trees that include piney/rosemary and phenolic/medicinal.

3.2.22 *toothpaste, n*—powder, paste, gel, or liquid for cleaning the teeth with the primary clinical benefit being the prevention of dental caries.

3.2.22.1 *Discussion*—Toothpaste products may or may not contain a form of fluoride as the common active ingredient and are generally intended for application with a toothbrush or similar device.

3.2.23 *unripe (green) fruit, n*—aromatic associated with underdeveloped fruit, for example, green bananas.

3.2.24 *warming, v*—perception of chemical heat associated with substances such as brown spice and low levels of capsaicin.

3.2.25 *wintergreen, n*—combination of several sweet aromatics associated with the mint family having some green and menthol aromatics along with a methyl salicylate aromatic sensation.

3.2.25.1 *Discussion*—Other associated characteristics with wintergreen typically include warming, low-level burning, and cooling, which are rated separately. Noncategory example: wintergreen breath mints and typical bismuth subsalicylate stomach remedies.

4. Summary of Guide

4.1 The development of expert descriptive sensory capability for the evaluation of toothpaste requires a very specific and deliberate approach to not only the evaluation of the product itself but also to the recruitment and training of potential evaluators for the evaluation of toothpaste. This guide provides approaches for the recruitment, screening, training, and final selection of panelists to evaluate the intensity and time course of the sensory physical characteristics of toothpaste.

4.2 Additionally, several approaches to the expert descriptive analysis of consumer products have been developed, each with its own particular strengths and drawbacks. Two of the most common approaches are the common application and use of toothpaste through the typical toothbrushing process using a toothbrush.

4.3 An alternate approach to the evaluation of some attributes of toothpaste that has been published in the sensory literature is the sampling of the product from a spoon.[3] This approach provides a mechanism for flavor, chemical feeling factor, and some mouthfeel characteristics without the concomitant irritation of the oral tissues that can accompany the use of a bristled toothbrush.

4.4 Specifics around the approaches for toothpaste evaluation are left to the reader as varied and equally valid descriptive analysis protocols can be developed.

[3] Hightower, C. A., and Chambers, E., "Descriptive Analysis of Toothpaste Flavor and Texture Using Two Sampling Methods: Brushing Versus Spoon Tasting," *Journal of Sensory Studies*, Vol 24, No. 3, 2009, pp. 301–316.

5. Significance and Use

5.1 The approaches to the evaluation of toothpaste recommended in this guide can be used to assess the sensory characteristics of toothpaste when dispensed, in use, and after use. This guide is meant to address the evaluation of a standalone toothpaste product and does not address packaging, product/package interaction, dispensing, appearance, or overall effect or benefit of the product. The procedures outlined in this guide are to be used by assessors that have been specifically screened for sensory and descriptive ability and have been trained in the evaluation of toothpaste. The procedures described in this guide can be used to guide product development within a manufacturer and can be used to communicate information regarding the product to the consumer through the media or on product packaging.

5.2 Additionally, language and ideas from two additional ASTM sensory guides (Guides E1490 and E2082) as well as the *Lexicon for Sensory Evaluation: Aroma, Flavor, Texture, and Appearance* (DS72)[4] are used throughout this guide.

6. Panel Selection and Training

6.1 *Objective*—To select and train a panel of 10 to 15 judges to evaluate sensory properties before, during, and after usage of toothpaste using descriptive analysis methods that quantify sensory attributes over time. For any particular study or evaluation, a smaller subset of these panelists may be used to generate data depending on project needs or objectives or both.

6.2 *Assessor Selection*—The following will cover points specific to toothpaste assessors. For more general considerations in the recruitment of a descriptive analysis panel, reference *ASTM STP 758*.[5]

6.2.1 Assessors are recruited from within a company or the local community. The choice to use employees allows a company to have the assessors on site and keep proprietary information confidential. The use of local community residents provides a smaller risk to panelist attrition both on a daily basis and longer term.

6.2.2 A large group of candidates are recruited from the local community by contacting community groups, posting on bulletin boards, websites, placing newspaper ads, or other such ways to communicate such as exploring social media. Candidates from within the company are contacted by interoffice memo, e-mail, company newsletter, or notices posted on regular and electronic bulletin boards. Management encouragement and support is critical. Before the prescreening questionnaire, candidates should be informed of the time commitment for training, potential duration of the panel, use of the panel, and expectation of each panelist relative to the responsibilities of the panel. The prescreening questionnaire is recommended for determining current product usage, oral care habits, availability, interest, and their ability to articulate perceptions.

6.3 *Prescreening Questionnaire*—The prescreening questionnaire should cover the following topics:

6.3.1 *Screening Questions Specific to External Panelists:*

6.3.1.1 *Availability*—Available for all mandatory training and 80 % or more of practice sessions. Be clear on exactly what the time commitment is.

6.3.1.2 *Clarification to the Candidate of the Scope and Expectation of the Role*—This is a standalone job/role with no expected addition to further company employment (if recruited externally). This is a part-time role without expectation to an increase in hours. Additionally, hours are based on study needs and are not guaranteed. Working in a group dynamic and group environment is essential. In regard to training, practice, validation, and long-term commitment, willingness to step outside of the oral comfort zone (trying things that they would not normally try, unusual flavors, sensation, textures, and strengths) is critical.

6.3.1.3 If products or materials used in training contain alcohol, caffeine, animal products, processed foods, and so forth, it is recommended that this be disclosed to potential panelists.

6.3.1.4 *Questions to Ascertain General Health and Condition*—Generally exclude potential panelists with food allergies, diabetes, hypertension not managed by medication (less than 140/90), on medications that noticeably affect their ability to smell/taste, have serious chronic medical conditions (for example, cancer), are pregnant, or are lactating. Further medical history and current medication assessment can be conducted in cooperation with safety, regulatory, and legal partners. If the candidate's medical history is collected, ensure that this is acceptable from a Human Resources (HR) perspective and not subject to the Health Insurance Portability and Accountability Act of 1996 (HIPAA) (or similar) restrictions.

6.3.1.5 *Oral Health and Condition*—Health and condition of mouth and teeth, the presence or absence of dentures or partials, and age may be considered when recruiting assessors for a toothpaste product panel. Unless the product is formulated to address denture wearers, it is recommended that denture wearers not be included in sensory toothpaste evaluations. It is also recommended that individuals who have chronic oral conditions, periodontal disease, excessive fillings, orthodontia, fewer than 80 % of their natural teeth, sensitivity to ingredients commonly included in toothpaste, and the presence of veneers be excluded. Individuals with food allergies should also be excluded. Issues such as tooth sensitivity, recent dental or oral surgery, tobacco use, and bridgework should also be considered when selecting assessors.

6.3.1.6 *Commitment—Training, Practice, Ongoing (Overall Length of Commitment)*—Amount of time invested in the candidate should balance with the amount of time the candidate delivers.

6.3.1.7 *Verbal Articulation (Gauged from Written Questions)*—The objective should not be called out to the panelist. If prescreening is done online, be very careful not to include questions in an online screener that can be answered through an internet search. Be very careful of how the question is asked and ensure that the answer will meet the objective. (Consider asking in this question the habits and practices of

[4] *Lexicon for Sensory Evaluation: Aroma, Flavor, Texture, and Appearance*, DS72, ASTM International, West Conshohocken, PA, 2011.

[5] *Guidelines for the Selection and Training of Sensory Panel Members, STP 758*, ASTM International, West Conshohocken, PA, 1981.

sweetened beverage consumption as a prequel to gustatory acuity screen outlined in 6.5.2.)

6.3.1.8 *Ability to Scale/Use a Scale*—Question can be done using visual stimuli (such as a partially filled beaker and so forth).

6.3.1.9 If doing an external recruit, carefully consider exclusion of sensitive industry/competition, as well as household members of current/former company employees or other sensory panel members.

6.3.2 *Screening Considerations Specific to Internal Panelists:*

6.3.2.1 Ability to commit based on travel, other business commitments, and so forth.

6.3.2.2 People cannot be on the panel who are directly involved with the project/product category (for example, all oral care product development should be excluded). They should be from a mix of other project categories to minimize response bias.

6.3.2.3 Do not recruit from areas of the building/facility that would compromise objective evaluation.

6.3.2.4 Panelists need to be completely blinded/shielded from the samples in their daily work for the entire testing period.

6.3.2.5 All the above are in addition to the qualifications of the external panelists listed in 6.3.1.

6.3.2.6 If internal panelist acuity data has been collected for previous studies, acuity should be reverified for the current project if the previous acuity screen does not apply to toothpaste evaluation.

6.3.3 Based on the results of the prescreening questionnaire, candidates are selected to participate in the acuity screening phase. Candidates meeting prescreening criteria are invited to an onsite session(s) for the assessment of sensory acuity, ability to perform the task, and ability to work independently and in a group.

6.4 *On-Site Screening:*

6.4.1 Candidates meeting the prescreening criteria are invited to an onsite session(s) for assessment of underlying sensory abilities. Sensory acuity screening should include but is not limited to tests of olfactory ability, gustatory ability, and texture sensitivity.

6.4.2 During the sensory screening process, assessors should demonstrate the ability to both evaluate products independently (without being a distraction to or be distracted by others) and participate in group discussions. For example, candidates may participate in a mock evaluation session of a toothpaste product for observation of their ability to work both independently and in a group.

6.4.3 It is recommended that a one-on-one interview be conducted for determination of fit to the role at the end of the screening process before the final selection of assessors. Questions that may be asked during the one-on-one interview are, but are not limited to:

6.4.3.1 If you were in a discussion in the group and everyone else on the panel disagreed with your position, what would you do?

6.4.3.2 If you took this job, how would it fit into your life/schedule/routine?

6.4.3.3 What questions do you have that have not been answered thus far?

6.5 *Acuity Screening*—Types of sensory acuity screening tests (minimum recruiting criteria is generally 75 to 80 % correct for identification).

6.5.1 *Olfactory Ability:*

6.5.1.1 Odor identification test (commercially available or self-developed odorants).

6.5.1.2 Rank three different intensities of a single odorant/odor class (within the categories of mint, spice, sweet aromatic, and floral).

6.5.1.3 Consider detection/identification threshold if active/excipients have a particularly sensitizing effect.

6.5.1.4 In context identification of odor sensations in toothpaste or a reasonable proxy, for example, gum, breath mint, and mouthwash.

6.5.2 *Gustatory Ability:*

6.5.2.1 *Taste Identification Test (Five Basic Tastes)*—Bitter and sour reversals may be considered appropriate.

6.5.2.2 Rank three different intensities of a single tastant.

6.5.2.3 *Screen for Differential Perception of High-potency Sweeteners*—Ask for the type of sweetener commonly used in foods/beverages.

(1) Watch Out—Rebiana, Acesulfame K, saccharin, sucralose, and aspartame users are generally not as sensitive to the difference in taste of high-potency sweeteners as sucrose or high fructose corn sweetener/syrup (HFCS) users. Also, people have developed a decreased sensitivity/acclimation to the sweetness.

6.5.2.4 In context identification/ranking of taste sensations within a toothpaste application or reasonable proxy (gum, breath mint, and mouthwash).

6.5.3 *Chemical Feeling Factor*—Differentiation of varied chemical feeling factors. Do not get burdened on sensation identification. Ensure the potential panelists can differentiate the following sensations (accurate identification and naming can be trained later):

6.5.3.1 Burning,

6.5.3.2 Cooling, and

6.5.3.3 Tingling.

6.5.4 *Texture Sensitivity*—Differentiation of varied textures as experienced in the oral cavity. Again, do not get burdened on the specific identification of these textures. Ensure that the potential assessor can distinguish between varied textures (accurate identification and naming can be trained later):

6.5.4.1 *Grit/Particle Differentiation:*

(1) Grit size, and

(2) Grit amount.

6.5.4.2 Product breakdown in mouth (in a toothpaste context or a reasonable proxy).

6.5.5 *Visual Acuity*—Differentiation of stimuli that differ on visual sensory dimensions. Again, do not get burdened on the specific identification of these dimensions. Ensure that the potential assessor can distinguish between varied experiences (accurate identification and naming can be trained later):

6.5.5.1 Color discrimination (for example, standard color blindness tests),

6.5.5.2 Opacity,

6.5.5.3 Particles, and

6.5.5.4 Shine.

6.5.6 Panel leaders should keep in mind that early attrition of selected assessors may be high once training has begun; thus, over-recruiting/over selection is advised.

6.6 *Training and Validation of Toothpaste Panel:*

6.6.1 *Panel Orientation:*

6.6.1.1 To begin training of the 10 to 15 selected assessors, the panel trainer shall orient assessors first to the general concepts such as the definition, components, and applications of descriptive analysis testing.

6.6.1.2 Three key areas to be covered during assessor orientation are:

(1) Attribute development,

(2) Standard brushing procedure, and

(3) Scaling.

6.6.1.3 Discussion and demonstration of each attribute are conducted for each category: appearance, aroma, flavor, texture, and residual. This establishes the overall structure of the descriptive analysis of sample properties. Assessors are encouraged to discuss each term, its definition, the protocol for evaluation, and the corresponding rating scale after they are demonstrated by the panel trainer.

6.6.1.4 Appropriate references and examples should be served to the assessors to ensure the same understanding of the attributes and to demonstrate the intensity ranges. This may take 4 to 5 h.

6.6.2 *Panel Practice*—The assessors should be practicing on a number of samples in a fashion that focuses on gross differences to start and moves towards discrimination of finer differences between samples. Assessors shall be able to discriminate toothpaste attributes, identify them, scale the intensities, replicate themselves consistently, and identify blind controls/duplicate samples as having very similar profiles. This is iterative or repeated exposure training depending upon the difficulty of the attributes. This may need to happen in shorter but more frequent sessions to avoid fatigue or overload. Visual cues to toothpaste can be difficult to control in the training environment, leading to the possibility that the panelists may learn to use appearance attributes (striping, colors, and so forth) to guide their flavor and texture evaluations. When practical, appropriate steps should be taken to prevent such bias. For example, one approach would be to use red light technology to negate potential color cues. Emphasis should be given to appropriate training with panelists to not allow visual attributes to influence flavor and texture evaluation.

6.6.3 *Validation*—Any one of the following methods can be used for panel or panelist validation. A typical practice is to validate panelists individually with the assumption that the validation of individual panelists supports the validation of the panel as a whole.

6.6.3.1 Choose three different toothpaste products that demonstrate significant differences on several attributes.

6.6.3.2 Replicate evaluations by a panelist within the new panel should demonstrate reasonable consistency in the evaluation of the products.

(1) Panel results from a recently trained panel of panelists may be compared to the results of the same samples from the established panel. The recently trained panelists should provide similar results in 80 % of all attributes.

(2) As part of panelist validation, feedback should be provided to the new panelists regarding their performance in the validation process.

(3) If a panelist fails to meet the standards of the validation process, additional training and practice are required after which the panelist should be given the opportunity to attempt the validation again.

(a) If the panelist fails to meet validation standards after a second attempt, it is recommended that the panelist is released from the panel.

6.6.4 *Panel Monitoring*—Three different factors can be monitored when reviewing data from the panel and assessors. These are generally similar to protocols used to validate the panel initially.

6.6.4.1 A measure of the variability within the panel (that is, among panel members) can be determined with three replications of three samples for all attributes and all assessors. The mean value and standard deviation for each sample for each attribute is computed. The assessors and panel leader can then examine the mean value for each sample and attribute versus each panelist's score. This permits the panel leader to see whether one or more assessors are rating consistently higher or lower than the panel as a whole on one or more attributes. Review of the standard deviations across attributes demonstrates whether some assessors have standard deviations that are more variable than most assessors and on which attributes. Large panel standard deviations indicate the need for a review of definitions, evaluation procedures, or reference standards for the attribute in question.

6.6.4.2 A measure of the repeatability of the panel as a whole can be monitored by analyzing three replications of the panel's evaluation of two or three samples of the same product type. An analysis of variance will determine whether the panel scores are the same for the same sample across the replicates. This analysis should be conducted for each attribute.

6.6.4.3 Analysis of the data collected from three replicates of two or three different samples (as used in 6.6.4.2) can provide information on judge-by-treatment interactions in the analysis of variance. A significant F value on any attribute indicates that one or more assessors are evaluating samples differently. Data for these attributes should be plotted to determine the assessors whose values are different from the panel as a whole.

6.6.4.4 Approximately every six months, repeat procedure as outlined in 6.6.4.1 – 6.6.4.3 to ensure proper panel performance.

7. Approach

7.1 Overall, the objective in applying the following procedure(s) is to leverage consistency between evaluation periods.

7.1.1 *Facility/Testing Environment:*

7.1.1.1 The testing facility should, as best as possible, mimic a standard bathroom facility in which consumers would typically brush their teeth. Infrastructure to be considered that is typically found in a toothpaste-use environment is: sink; counter space; mirror; light; running water; capacity for

expectoration; heating, ventilation and air conditioning (HVAC)/air evacuation system; and appropriate space and means for recording responses/data.

7.1.1.2 Additional environmental control considerations are: water hardness, water pressure, ambient temperature, ambient humidity, and ventilation/air exchange system.

7.1.1.3 Lighting conditions if visual assessments are being performed: lights should be vertical in the booth not horizontal and lights should simulate daylight. Additionally, red light conditions may be considered when visual bias shall be mitigated.

7.1.1.4 If panelists are being recorded or photographed during the brushing process, panelist notification of this process is required.

7.1.1.5 Working in an environment with water, panelists should be provided with paper towels.

7.1.2 *Sample Preparation and Presentation:*

7.1.2.1 *Dispensing/Measurement of Product for Evaluation*—In general, a consistent measured amount is desirable in the dispensing of toothpaste for sensory evaluation. The amount dispensed should be "reasonable" based upon normal consumer use or comparable to the manufacturer's recommended amount per use.

7.1.2.2 *Delivery of Product to the Oral Cavity for Evaluation*—Two specific avenues for evaluations are appropriate for the evaluation of toothpaste properties:

(1) Brushing with Toothpaste Using a Typical Manual, Battery Operated, or Rechargeable Toothbrush—Special consideration should be given to identical brushes being used throughout the entire study to minimize variability as a result of the brush. Consideration should be given to selecting a brush with potential long-term availability to allow for comparison of data across studies over time.

(2) Tasting Toothpaste from a Spoon (Hightower and Chambers[3]*)*—Special consideration should be given to the long-term availability of the type of spoon used to deliver the product (plastic, metal) and the size of the spoon used such that these variables do not have an impact on the sensory impression of the paste and allow for consistent comparison of data over time.

7.1.3 *Preparation of the Samples for Brushing*—Toothpaste can either be dispensed directly onto the brush or dispensed into a serving vehicle, such as a weigh boat, and then given to the panelist for application to the brush by the panelist for evaluation. Neither of these dispensing procedures is without risk. For example, a predispensed amount of paste on the brush may result in some paste sinking into the bristles before serving and, depending on the physical properties of the brush, may limit the full quantity of paste from being evaluated. When the paste is provided to the panelist in a vehicle for application to the brush, an inherent variability between panelists will exist for quantity left in the vehicle that could also affect results.

7.1.3.1 *Preparation of the Samples for Evaluation from the Spoon*—A measured, consistent amount of toothpaste should be dispensed directly onto the spoon and handed to the panelist for evaluation. To protect the integrity of the dentifrice, product should be dispensed no sooner than 10 min before evaluation. Depending on the physical properties of each individual toothpaste product, some products may need to be dispensed and evaluated immediately.

7.1.4 *Sample Evaluation Procedure*—The objectives of the study will determine which specific procedure will be adopted.

7.1.4.1 *Evaluation Procedures*—Careful consideration of the following points and justification of the approach are critical in the development of a robust brushing measurement tool for the sensory attributes of toothpaste. A brushing procedure is recommended for an in-depth and in-context evaluation of toothpaste when all attributes are under consideration.

7.1.4.2 *Toothbrush*—When using a toothbrush to evaluate the sensory properties of toothpaste, several considerations shall be taken into account and justified in defining the brush to be used since the type of brush can affect the evaluation of the product. Special consideration shall be given to: bristle texture/softness, head size, and modality of brush (power, battery operated, and rechargeable). Brush characteristics may be played out not only in the interaction between toothbrush and toothpaste but also in the interaction of the soft tissue of the evaluator. Above all, the objective of the individual study (product development, claims support, and so forth) should dictate the type of brush used in the evaluation. Typically, a brush or brush head (in the case of power brushes) is used only once or only for a specific sample within a single study.

7.1.4.3 *Brushing Procedure*—Within a single study, study documentation should include evidence that the following variables were considered, how each was trained/addressed with the panel, or how the user is justifying their approach to managing the variables within and across panelists, or combinations thereof:

(1) Toothbrush age/number of prior uses,
(2) Length of brushing time,
(3) Type of brush strokes,
(4) Speed of manual brush strokes,
(5) Brushing location,
(6) Brush angle,
(7) Teeth covered,
(8) Applied pressure,
(9) Brush speed (for variable speed power brushes),
(10) Expectoration:
  (a) Frequency and
  (b) Intervals,
(11) Rinsing:
  (a) Frequency,
  (b) Length of rinse time, and
  (c) Volume,
(12) Brush wetting, and
(13) Washout period between samples.

7.1.4.4 *Panelist Control Procedure*—Within a single study, the following variables for the panelists' state of the oral cavity should be defined, justified, controlled across panelists, and documented:

(1) Eating/drinking restrictions,
(2) Smoking restrictions,
(3) Time of last brush/rinse/floss, and
(4) Oral care routine at home:
  (a) Brush,

(b) Paste,
(c) Rinse, and
(d) Floss.

(5) Oral state because of food/beverage consumption or prior oral hygiene before evaluation or both,

(6) Washout substance,

(7) Toxicology/safety (including number of brushings that can be performed by a single panelist per day based on gum safety, fluoride exposure, and so forth)

(8) Order effects,

(9) Number of brushings per session, and

(10) Length of time between sessions.

7.1.4.5 *Evaluation from a Spoon*—Careful consideration of the following points and justification of the approach are critical in the development of a robust spoon-based measurement tool for the sensory attributes of toothpaste. Evaluation of toothpaste from a spoon is recommended for a rapid and preliminary evaluation of the flavor, chemical feeling factor, and some texture attributes of toothpaste.

(1) In addition to the panelist control procedures outlined above, within a single study the following additional variables for the spoon evaluation process should be defined, justified, controlled within or across panelists, and documented as best possible:

(a) Spoon manipulation,
(b) Application procedure of product to oral tissue,
(c) Manipulation procedure of the product,
(d) Manipulation time of the product,
(e) Expectoration technique, and
(f) Rinse:
(1) Frequency,
(2) Time, and
(3) Volume.

8. Keywords

8.1 sensory testing; toothpaste; toothpaste descriptive analysis