

Title

Sensory attributes of coated tablets: developing a formal lexicon and sensory wheel

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Abstract

The patient's sensory experience when taking an oral medicine is important in the assessment of its palatability, and acceptability.. The aim of this study was to develop tools useful for standardization of sensory assessment of coated tablets: a lexicon and a sensory wheel.

Two randomised, double-blind sensory assessments were performed involving 83 and 52 healthy adult volunteers and two sets of coated tablets. By adapting the principles used by food sciences, a free-text description of conventional, bitter-tasting or tasteless, coated tablets was performed. In the first assessment, volunteers described the sensory attributes of the first set of tablets. The attributes collected were then validated using a second set of tablets in a separate study with different volunteers. The appropriateness and semantics of each sensory attribute was analysed. Twenty-two attributes most relevant for assessment of coated tablets were selected for the lexicon and associated with explicit definitions. A collection of all attributes that could possibly be triggered by coated tablets were organised in the form of a sensory wheel. This study provides a valuable insight into the sensory experience while taking a coated tablet, and presents tools which can accelerate the development of palatable medicines.

1 Introduction

Little is known about the sensory attributes of pharmaceutical formulations and how these influence product acceptability. The acceptability of any medicine to a patient is a determinant of adherence. Acceptability is defined as “the ability and willingness of a patient to self-administer, and also of any of their lay or professional caregivers, to administer a medicinal product as intended”, and acceptability studies within the intended target population are a regulatory requirement (EMA, 2013; EMA, 2017). A patient’s acceptance of an oral medicine is a complex mix of practical and psychological considerations. On a practical level, acceptability relates merely to the ability to successfully take a medicine. Psychologically, the sensory (and physical) attributes (e.g. taste, smell, surface and bulk texture, mouthfeel, colour, size, shape) of the medicine have an important influence on palatability and a patient’s willingness to take their medicine (European Medicines Agency, 2013). Despite the complex nature of acceptability, the attributes most commonly measured during oral medicine development are taste and overall palatability (Thompson *et al.*, 2013). Few studies investigate multiple sensory attributes of oral medicines and their influence on overall palatability and subsequent acceptability.

Pharmaceutical sensory research is an emerging area of interest. Sensory research uses human panels to measure sensory perception and generate a quantitative objective product description. The overall sensory perception of a product is a combination of stimuli that interact with different receptors, e.g. chemoreceptors, thermoreceptors, mechanoreceptors. With the help of sensory testing, the complexity of sensory perception can be broken down into individual components, i.e. sensory attributes.

A lexicon, which provides lists of attributes relevant for sensory assessment with precise, unambiguous definitions of the sensory experiences triggered by a product, is fundamental to sensory assessment (Dubois, 2006). The use of precise, unambiguous definitions ensures that the lexicon generated is meaningful to those involved in testing. For food products, lexicons of sensory attributes have been developed and validated for particular product groups (e.g. cashew nuts or soy sauces). These clearly defined sensory attributes can be further interrogated using a method called descriptive sensory analysis, where each attribute is scaled to provide qualitative and quantitative measures of intensity (Murray, Delahunty and Baxter, 2001). Such scaling uses defined products chosen to be representative of the scale extremes (i.e. intensity reference products). For example, gelatine dessert, potato chip and thin bread wafer can be used to anchor low, medium and high levels of roughness respectively (Lawless and Heymann, 2010b).

Sensory lexicons can be further refined into a sensory wheel; a comprehensive collection of the sensations that could be triggered by a product. They are often representative of an entire product category (e.g. the coffee wheel) and sometimes divided by sensation (e.g. white wine has a separate aroma and mouthfeel wheel) (Lawless and Civille, 2013). Within the wheel, sensory attributes are categorised (e.g. by stimuli or flavour) and arranged hierarchically. This provides an overview of a product’s sensory attributes and facilitates

systematic assessment (Imamura, 2016). Sensory lexicons can be used as a communication tool to guide a product's development, while sensory wheels are widely used to define taste, flavour and other detailed characteristics of a product. Combined with consumer feedback, sensory assessment provides an opportunity to relate how much a product is liked to its sensory attribute profile (Suwonsichon, 2019). Developing sensory lexicons and wheels for oral medicines has the potential to provide a tool to standardise the description of a product's sensory attributes thereby informing its palatability and acceptability

In food *in vivo* testing, there is a clear distinction between, sensory science which uses a trained panel of individuals to test and describe the product, and consumer science, which uses a large group of consumers to do so (Yang and Lee, 2019). Further, sensory science panels measure perceptions of sensory stimuli and generate an objective product description, while consumer science panels measure hedonic reactions and subjective opinions (Yang and Lee, 2019). This approach is not translatable to pharmaceutical sensory testing. Firstly, due to a lack of sensory panels trained for pharmaceutical products, and secondly as the target patients may not be accessible or numerous enough. Moreover, patients as the target population are distinct from a food consumer, in that they can have morbidity-affected senses and thus have different acceptability requirements. As a result, in pharmaceutical sensory science, the group of choice are usually healthy adult volunteers.

Pharmaceutical products are designed to trigger an acceptable sensory perception, rather than a pleasing one (EMA, 2013). In pharmaceuticals, sensory studies provide information about the attributes that can compromise or ensure acceptability, whereas in food science sensory studies are carried out to explore the richness of the flavours and texture of the product. Secondly, pharmaceutical dosage forms are designed to be acceptable to widest possible population, while sensory studies in food industry can also aim to develop a unique product to satisfy niche population of consumers (Stone, Bleibaum and Thomas, 2012).

. The aim of this study was to explore the sensory attributes of conventional coated tablets, as an example of a typical oral solid dosage form (OSDF), in order to develop a sensory lexicon and wheel representative of this product group. To do this, the principles used for sensory analysis of food products were adapted and applied to a set of bitter tasting tablets and a set of tasteless tablets, each with a range of different coatings.

2 Materials and methods

2.1 Tablet samples

Developing a lexicon and sensory wheel requires the use of a diverse set of samples in order to capture all potential sensory attributes (Koch *et al.*, 2012). A total of nine placebo formulations were chosen to provide a range of tasteless and bitter-tasting tablets with different coatings. All tablets were designed to be swallowed with water rather than chewed or retained in the mouth (conventional tablets).

Two sets of conventional tablets were used: oval T_A and round T_B. The set of T_B tablets contained quinine, 2.5% (w/w), as a bitter tasting agent. Both sets of tablets were film coated, the film compositions are listed in Table 1. All tablets were manufactured to allow human consumption. T_A tablets were manufactured by VerGo Pharma Research Laboratories Ltd., T_B by Chrysalis Health & Beauty Ltd. All tablets were white.

Table 1 List of formulations used in the study.

| | Formulation | Tablet coating description | Coating ingredients | Final coating level (w/w)* | Tablet core |
|-----------------------|-----------------------|-----------------------------|--|----------------------------|-----------------|
| First set of tablets | T _A | Uncoated | - | 0% | Oval, tasteless |
| | T _A Coat-1 | Standard commercial | Opadry® 03F mix (HPMC-based) | 3% | Oval, tasteless |
| | T _A Coat-2 | Slippery commercial | Opadry® EZ Swallow white (HPMC-based + hydrocolloid gum and MCT) | 3% | Oval, tasteless |
| | T _A Coat-3 | Slippery commercial | Opadry® EZ Swallow white Opadry® EZ Swallow clear (HPMC-based + hydrocolloid gum and MCT) | 3% + 1% | Oval, tasteless |
| Second set of tablets | T _B Coat-4 | Standard reference | HPMC 5, glycerol | 4% | Round, bitter |
| | T _B Coat-5 | Lipid based | Lubritab®, Capmul® MCM, HPMC 5, talcum, titanium dioxide | 4% | Round, bitter |
| | T _B Coat-6 | Slippery | HPMC 5, xanthan gum, glycerol, talcum, titanium dioxide | 4% | Round, bitter |
| | T _B Coat-7 | pH dependent | Eudragit EPO readymix, titanium dioxide | 4% | Round, bitter |
| | T _B Coat-8 | Insoluble – soluble polymer | HPMC 5, Surelease®, glycerol, talcum, titanium dioxide | 4% | Round, bitter |

*as declared by manufacturer

HPMC – hydroxypropyl methyl cellulose

MCT – medium chain triglycerides

2.2 Lexicon and sensory wheel development pathway

The sensory attributes of the coated tablets were collected as part of two separate studies Hofmanová *et al.* (2019) and Hofmanová *et al.* – manuscript in preparation). The sensory panels for both studies were healthy untrained adults between the ages of 18 and 75 years. The first study, assessing the T_A set of tablets, used a panel of 83 participants, resulting in total of 332 evaluations. The second study assessed the T_B set of tablets and used a different panel of 52 participants, resulting in total of 260 evaluations. Figure 1 presents the lexicon development pathway used.

2.2.1 Generating an initial list of attributes (Step 1)

The first sensory study generated an initial list of attributes relevant for the product (Figure 1, Step 1). One uncoated and three coated tasteless tablets (T_A tablets) were presented to participants in a randomised order to reduce sequential bias. Participants were instructed to hold each tablet, one at a time, in their mouth for 10 seconds, feel its surface with their tongue and then spit out or swallow the tablet according to their preference. Immediately after each tablet, participants were asked to “describe in three words how the product feels in the mouth” using free text. Between each tablet, participants were given a palate cleanser to eliminate carry-over effects. The palate cleanser comprised drinking spring water at room

temperature followed by a piece of lightly salted cracker (Jacob's, or Schar gluten free) then water again (Lucak and Delwiche, 2009).

2.2.1.1 Refining the initial list of attributes – data cleaning (step 2)

To clean the data, participant "free text" descriptions were transcribed, unified grammatically, and shortened without any change of meaning (Kumar and Chambers, 2019). Qualifiers (e.g. *little, slightly*) and illegible responses were disregarded (ISO, 1994). The appropriateness and semantics of each attribute were then analysed. Attributes with redundant, vague meanings or non-existent words were excluded. Also hedonic attributes (e.g. *pleasant, bad*) were excluded as not relevant for sensory assessment (ISO, 1994). Ambiguous attributes (e.g. *clear*, which could express different meanings, such as *clean, plain, or transparent*), were excluded to reduce the risk of misinterpretation. The resultant list of attributes (list A) was taken forward for validation.

2.2.2 Validation (step 3)

In a second separate study, the set of T_B tablets was subject to a sensory assessment panel using the same methods as for the set of T_A tablets (section 2.2.1). However, in this study participants were presented with five coated tablets, containing a bitter tasting agent (quinine), in a randomised order. In addition, when asked to "describe in three words how the product feels in the mouth" (free text), participants were given the choice of list A attributes and/or their own words.

According to several authors, the attributes which should be included in a lexicon are those generated in the highest frequency (Henley, 1969; Szczesniak and Kahn, 1971; Antmann *et al.*, 2011). Six key attributes of tablets (*sticky, smooth, rough, slippery, bitter and aftertaste*) were automatically included in the lexicon. The first four were included as they were most abundant in the first study (over 40 mentions) and the last two because they were considered innate to the quinine content of T_B tablets. The frequency of attributes chosen from list A was then considered. Any attribute chosen six or more times (i.e. used by more than 10% of participants (Antmann *et al.*, 2011)) was regarded as relevant to describe coated tablets and therefore also considered "validated" generating list B.

2.2.3 Refining the validated list – term reduction (step 4)

Validated attributes (list B) together with the key attributes were further refined on the premise that the number of attributes required for efficient sensory evaluation, and hence inclusion to the lexicon, is about 20 (Vannier, Brun and Feinberg, 1999). Attributes with opposing meanings and intensity descriptions were reduced to a single attribute. Synonyms were deleted. Where relevant, lay vocabulary was replaced with more pharmaceutical terminology e.g. *fall apart* was changed to *disintegrating*. The resultant list of attributes was included in the lexicon.

2.2.4 Generating a lexicon (step 5)

Explicit definitions were established for the final list of attributes based on published literature. Attributes were then grouped into conceptually related categories analogous to food science research (Drake, Yates and Drake; Kim *et al.*, 2013; De Pelsmaeker *et al.*, 2019).

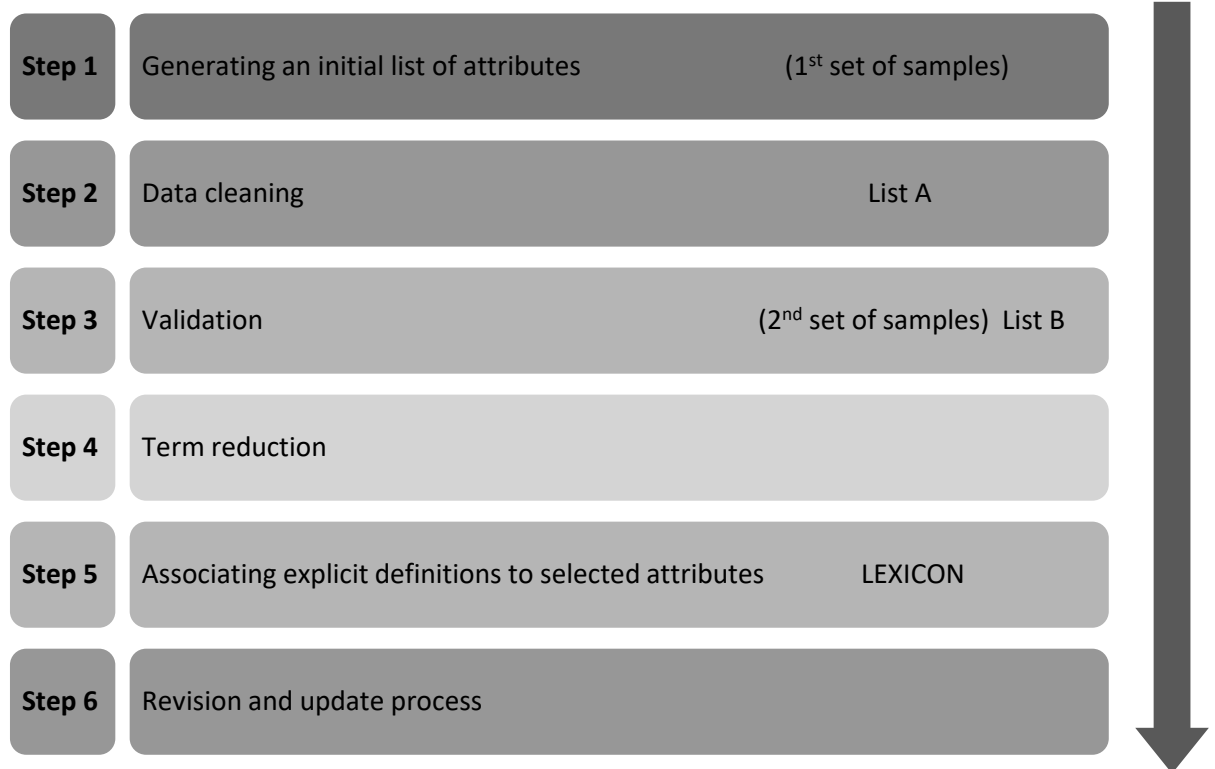


Figure 1 Process of building a lexicon for tablets; Step 6 is a prospective process (not reported in this preliminary study).

2.2.5 Generating a sensory wheel

A sensory wheel was generated by collective analysis of the attributes collected from both tablet sets. From the first study attributes on the list A were included. From the second study, newly generated attributes (i.e. those generated by free text responses which were not on List A) were subjected to the same data cleaning process as conducted in study one (section 2.2.2.1). The attributes obtained, were grouped into categories based on the stimuli involved in the perception of each attribute. Five categories were used: touch, taste, vision, motion, and others. A motion category was created to gather attributes referring to movement of the tablet or changes associated with the tablet during assessment. The sensory wheel was generated using XLSTAT software version 2019.4.1 (Addinsoft).

3 Results

3.1.1 Generating attribute lists

Free-text descriptions in these studies used consumer-based language. Participants generated 883 comments with the tablet set from the first study (T_A). Data cleaning left 98 sensory non-repetitive attributes (Table 2). Exclusion of the most abundant terms which were

considered automatically validated (i.e. those related to *stickiness, smoothness, roughness* and *slipperiness*) and removal of the terms being innate to quinine (i.e. those related to *bitterness* and *aftertaste*) generated list A, consisting of 74 attributes (Table 3). In the second study, where list A was used as a participant prompt, a total of 730 comments were generated (Table 2). Of the list A attributes, 41 of the 74 were frequently chosen (over 6 times) and hence considered validated (Table 3), and a further 25 attributes were generated. For both studies, responses varied from single words (e.g. *smooth*) or even exclamations (e.g. *Ugh*) to full sentences (e.g. *didn't think it would ever dissolve if I couldn't swallow it*). A full list of participant comments is available in Appendix 1.

Table 2 Frequency of collected participants' comments and attributes.

| | Number of cases | |
|-----------------------------------|-----------------|--------------|
| | First study | Second study |
| All comments | 883 | 730 |
| Valid comments* | 806 | 719 |
| Varying non-repetitive attributes | 128 | 111 |
| Hedonic attributes | 30 | 17 |
| Sensory attributes | 98 | 94 |
| Shared sensory attributes | | 69 |
| Unique sensory attributes | 29 | 25 |

*nonsensical and illegible comments excluded

Table 3 List A: Seventy-four attributes from the first tablet set (T_A) with frequency of occurrence from the second tablet set (T_B); shaded area - List B: forty-one most frequently used attributes (i.e. validated attributes).

| | | | | | | | |
|------------------------|----|---------------------------|----|----------------------|---|-----------------------|---|
| <i>neutral</i> | 35 | <i>dusty</i> | 11 | <i>floury</i> | 6 | <i>gooey</i> | 1 |
| <i>chalky</i> | 30 | <i>light</i> | 11 | <i>soft</i> | 6 | <i>minty</i> | 1 |
| <i>dry</i> | 26 | <i>plastic</i> | 11 | <i>thick</i> | 6 | <i>pointy</i> | 1 |
| <i>solid</i> | 25 | <i>doesn't fall apart</i> | 10 | <i>pasty</i> | 5 | <i>spongy</i> | 1 |
| <i>chemical</i> | 24 | <i>doesn't melt</i> | 10 | <i>artificial</i> | 4 | <i>aniseedy</i> | 0 |
| <i>movable</i> | 20 | <i>glazed</i> | 10 | <i>gooey</i> | 4 | <i>big</i> | 0 |
| <i>moves easily</i> | 19 | <i>silky</i> | 10 | <i>melts</i> | 4 | <i>disintegrating</i> | 0 |
| <i>rounded</i> | 19 | <i>alkaline</i> | 9 | <i>not movable</i> | 4 | <i>falls apart</i> | 0 |
| <i>bland</i> | 18 | <i>clingy</i> | 9 | <i>shiny</i> | 4 | <i>fizzy</i> | 0 |
| <i>plain</i> | 18 | <i>grainy</i> | 9 | <i>solvent taste</i> | 4 | <i>fluffy</i> | 0 |
| <i>small</i> | 18 | <i>no flavour</i> | 9 | <i>creamy</i> | 3 | <i>furry</i> | 0 |
| <i>matte</i> | 17 | <i>dissolving</i> | 8 | <i>granular</i> | 3 | <i>gelatinous</i> | 0 |
| <i>synthetic</i> | 16 | <i>gluey</i> | 8 | <i>gritty</i> | 3 | <i>glutinous</i> | 0 |
| <i>unnatural taste</i> | 16 | <i>no edges</i> | 8 | <i>not tacky</i> | 3 | <i>large</i> | 0 |
| <i>slick</i> | 15 | <i>doesn't dissolve</i> | 7 | <i>starchy</i> | 3 | <i>mushy</i> | 0 |
| <i>powdery</i> | 13 | <i>mobile</i> | 7 | <i>adherent</i> | 2 | <i>pliable</i> | 0 |
| <i>clean</i> | 12 | <i>slimy</i> | 7 | <i>bumpy</i> | 2 | <i>soggy</i> | 0 |
| <i>hard</i> | 12 | <i>tacky</i> | 7 | <i>loose</i> | 2 | | |
| <i>no taste</i> | 12 | <i>tasteless</i> | 7 | <i>crumbly</i> | 1 | | |

3.2 Generating a lexicon

Of the validated list of 41 attributes (Table 3) and 6 selected key attributes (*sticky, smooth, rough, slippery, bitter* and *aftertaste*), 20 (as recommended by Vannier et al. 1999) were selected for lexicon inclusion and defined (Table 4). Of these, 10 were related to texture, 3 to taste, 1 to flavour, 2 to visual perception, 3 to change-of-state of the tablet, and the remaining 1 was not classified. In food sciences, it is a standard practice to assign one or more reference products to each attribute to indicate an intensity scale (Lawless and Civille, 2013). However, there is minimal knowledge of adequate reference products or appropriate intensity ranges for OSDFs. These factors coupled with ethical considerations regarding the use of actual medicines as reference products meant that no reference products were assigned in this study.

Table 4 Tablet lexicon with sensory attribute definitions. Definitions were based on [1] ISO standard, textbooks [2] Meilgaard, Carr and Civille (2006), [3] Lawless and Heymann (2010a), [4] Cambridge English Dictionary (2019) or other lexicons [5] Civille et al. (2010), [6] Kim et al. (2013), NA - not available.

| Attribute | Definition | Ref |
|--------------------------|---|----------|
| Texture | | |
| Chalky | Associated with chalk, dry sensation in the mouth | [2] |
| Dry | Free from moisture or liquid, perception of moisture being absorbed by product | [1], [4] |
| Powdery | Amount of fine particles on the surface or as bulk product | [5] |
| Slippery | Degree to which sample slides across the tongue/palate | [2] |
| Adhesiveness | Degree to which the sample adheres to mouth surfaces: lips, tongue, palate, teeth (with increasing intensity level: tacky, clinging, gooey – gluey, sticky – adhesive) | [1] |
| Slimy | Covered in a sticky, smooth, liquid substance, as liquid covering snails | [4] |
| Smooth | Having regular/even surface, lack of lumps or abrasive particles | [2] |
| Rough | Degree of irregularity/unevenness of the product's surface; assessed by rubbing the surface | [5] |
| Granularity | Containing particles/granules detected by assessed by rubbing product between tongue and palate (with increasing intensity and particle size: smooth, gritty, grainy, beady, granular, coarse, lumpy) | [1] |
| Hard | Force required to compress/break the sample | [1] |
| Taste | | |
| Bitter | Innately aversive basic taste sensation characteristic to caffeine | [1] |
| Tasteless | Having no taste, lack of chemical stimulation of taste buds | [4] |
| Aftertaste | Taste or odour sensation that occurs after the elimination of the product | [1] |
| Flavour | | |
| Chemical | Flavour associated with artificial products | NA |
| Visual perception | | |
| Size | Relative description of size (small – large) | [4] |
| Gloss | The tendency of a surface to reflect light (shiny – matte) | [1] |
| Change-of-state | | |
| Dissolving | Degree to which the core of the sample dissolves in contact with saliva | NA |
| Disintegrating | Degree to which the core of the sample breaks up into small parts in contact with saliva | NA |

| | | |
|--------------|---|-----|
| Solid | Keeping a clear shape, object without any spaces or holes, integrity of shape | [2] |
| Other | | |
| Neutral | Lack of dominant or noticeable characteristics | [1] |

3.3 Sensory wheel

The attributes collected in both studies, after data cleaning, were grouped into categories based on the type of stimuli, and presented in the form of a sensory wheel (Figure 2). Five categories were used: touch, taste, vision, motion, and others. Attributes perceived by touch were further organised into groups related to product surface, structure, and hardness of the tablet. Due to their relative abundance, attributes describing varying levels of stickiness were assigned a separate group. In a sensory wheel, the most general attributes are placed at the interior, and more specific at the exterior.

Participants reported a sensation of four out of five basic tastes; only umami was not represented. Even though tablets contained no additional flavours, some responses mentioned a *minty* or *aniseedy* flavour. Several attributes describing the visual perception of the tablets were collected, these related to size and surface. None of the participants generated attributes describing smell or hearing perception. Some participants reported that the tablet underwent a change of structure in the mouth (e.g. *disintegrate*, *dissolve*, and *melt*). These were grouped into a motion category.

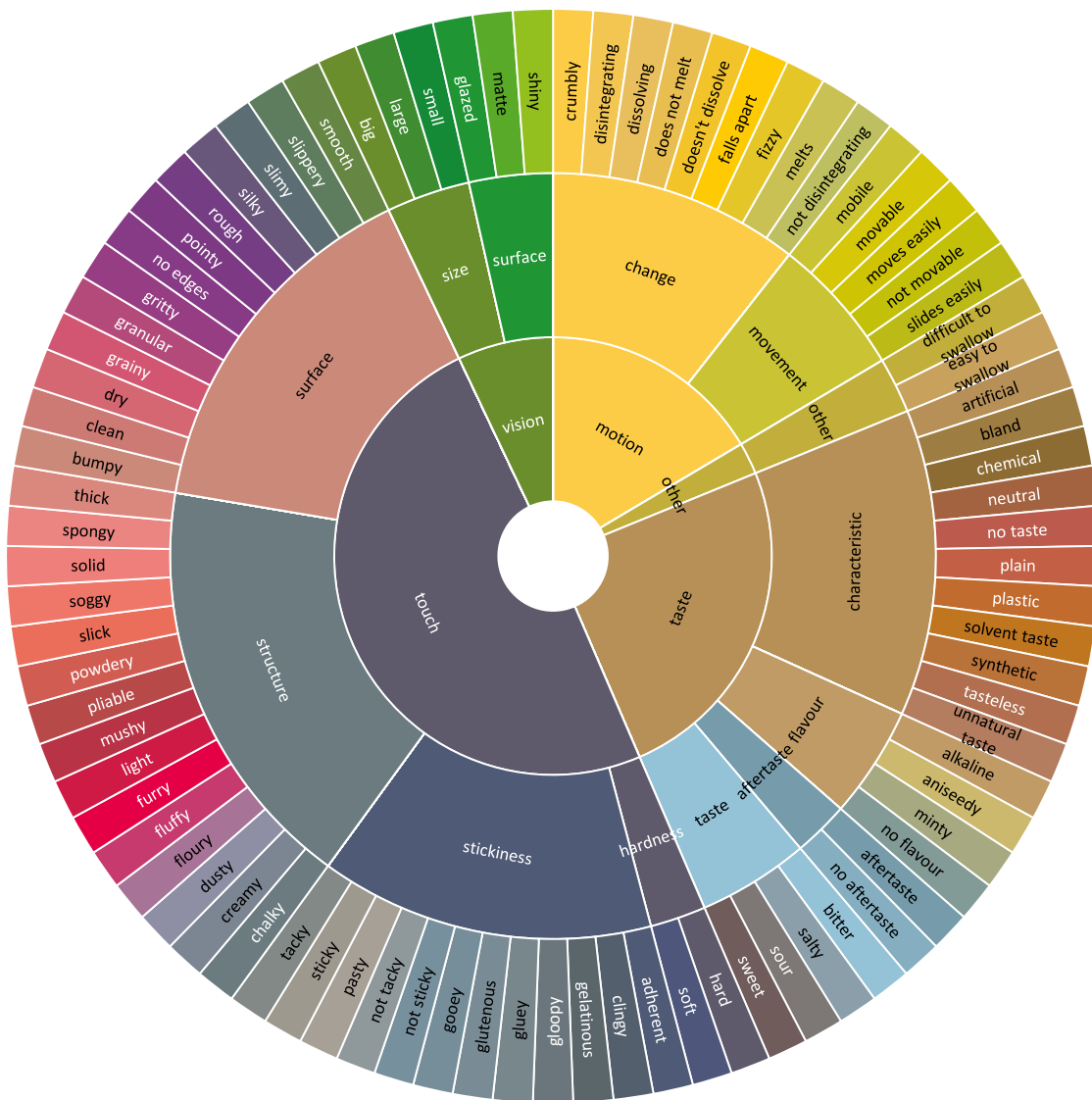


Figure 2 Tablet sensory wheel.

4 Discussion

4.1 Nature of tablet sensory assessment

The patient's sensory experience when taking an oral medicine is important in the assessment of its palatability, and therefore its acceptability. Yet, there is limited understanding of the sensory attributes which are most critical for acceptance of medicines. This study explored the sensory attributes of conventional coated tablets and gathered the vocabulary used by patients (consumers) to describe the tablets.

Sensory analysis revealed that various senses are involved in the perception of tablets. Participants mainly used expressions related to touch, taste, and vision with a notable absence of any attributes related to hearing or smell. The omission of vocabulary relating to these two senses is likely to be due to tablet characteristics. Auditory perception of medicine (or food) is specific to products that create sounds during mastication (i.e. chewing gum or crisps) rather than tablets, which in this study, were swallowed whole and not chewed. In

addition, the tablets were odourless hence there was no olfactory stimulation. Nevertheless, many medicines contain volatile substances, thus the perception of smell is expected for some flavoured or drug containing products.

Sensory perception of tablets is distinct from that of food products. Conventional tablets are swallowed whole as a solid unit hence their oral perception is mainly due to taste and tactile stimuli. Potential taste stimuli of a conventional coated tablet can arise from the coating, active pharmaceutical ingredient (API) or excipients, although taste-masking coatings will reduce the latter two. Tactile stimuli arise from the interaction of the tablet surface (e.g. the coating) with the oral cavity and is likely to have the greatest influence on sensory perception due to the short residence time in the mouth. Although the texture of tablets may seem unnoticeable, the findings from this study demonstrate the opposite. During administration, the tablet is moistened with saliva and its surface sheared by tongue-palate-teeth movement which changes the tablet structure (and tablet coating structure), which alter the sensations perceived by the patient. The characteristics of the tablet coating, therefore, are important; firstly, because they modify the surface properties of the tablet and secondly, due to presence or lack of taste-masking function.

Based on participants' comments, not only the texture itself but also changes in texture over time are identifiable. In fact, participants used several attributes describing tablet structure change, e.g. *falling apart*, *dissolving*. This suggests that sensory analysis for conventional tablets should be performed in a time-dependent manner. To capture taste/texture changes over time, methodology could be adopted from the Temporal Dominance of Sensations (TDS) technique which is well established in food sciences (Varela and Fiszman, 2012). Texture is more likely to be of importance for an orally disintegrating dosage forms (ODTs) than conventional tablets. Indeed, studies have been conducted reporting the changes in intensity of roughness/grittiness over time for these formulations (Douroumis, Gryczke and Schminke, 2011; Kimura *et al.*, 2015; Wang, Hu and Sun, 2017).

4.2 Challenges in lexicon development

This work constitutes the first step to build a formal lexicon for conventional coated tablets (Table 4). According to accepted standards, a full lexicon includes a list of attributes and definitions that describe a product, as well as a set of references that clarify the terminology (Lawless and Civille, 2013). However, certain difficulties arise when developing a lexicon for pharmaceutical sensory analysis. Firstly, there are gaps in knowledge regarding the textural attributes critical to patient palatability, and therefore acceptability for SODFs. Secondly, the lack of diversity in the sensory attributes of pharmaceutical products, leads to difficulties in obtaining a reference intensity scale. Furthermore, obtaining appropriate reference products for SODFs may be complicated by the need for good manufacturing practice (GMP) or at least human consumption standards of production as well as the ethical burden to participants. However, this issue would be mitigated if a placebo reference set were developed and mass produced as industry standard references.

The vocabulary collected in this work was used to map the participant sensory perception of coated tablets. The analysis showed that the texture vocabulary used to describe tablets is

rich but not standardised. For example, a feeling of fine particles on the tablet surface was described using different attributes i.e. *chalky, floury, powdery, and dusty*. In addition, various attributes can build intensity scale of specific property, i.e. adhesiveness, ordered as: *tacky, clingy, gluey, and sticky*.

The complexity of sensory analysis lies in the language specificity of the individual. In particular, the choice of word depends on the richness of one's vocabulary, and the mother tongue of each participant. Moreover, texture can be characterised differently across the world due to varying food and language cultural references (Varela *et al.*, 2008). The type of words collected might also be compromised where panels of participants are not trained. We hypothesise, that participants used words such as *dissolving, melts, crumbly*, to indicate that tablets disintegrated in the mouth. This suggests (i) that lay participants do not know pharmaceutical jargon (e.g. *disintegrate*), and (ii) clear definition of attributes is necessary for unambiguous communication. Furthermore, using lay participants gave rise to many hedonic attributes not relevant to sensory evaluation. Unlike a panel trained to use only objective attributes, a lay person tends to use simpler language and hedonic attributes in their evaluation (Chollet and Valentin, 2001). For a consumer, hedonic attributes express their feelings rather than an objective description of mouthfeel, for example XXXXX. Although hedonic attributes are not included in lexicons, they may be presented to lay participants as type of words "not to use" in sensory evaluation.

The lack of uniform terminology can impede communication, particularly when the same word is used by one participant to express one sensation and is used by others to express something else. Thus, without presenting a definition of each attribute to the participant, one cannot be sure the exact perception described. A formal lexicon with defined terminology would reduce ambiguities in the interpretation of the sensory analysis of OSDFs.

4.3 Practical implications of a tablet lexicon and sensory wheel

This study identifies sensory attributes not previously reported to be associated with conventional coated tablets. Both the sensory lexicon and wheel developed in these studies have the potential to inform product development and accelerate the evaluation of a SODF's palatability and hence acceptability.

The developed lexicon can benefit future sensory studies by providing a list of well-defined attributes relevant for oral perception of tablets. Moreover, it can be used in descriptive sensory analysis, where intensity of each attribute is scaled by a human panel. The strength of such quantitative evaluation is an ability to link its results with acceptability evaluation, i.e. define the point at which attribute intensity changes from pleasant to unpleasant. This way the characteristics of acceptable and unacceptable product can be determined.

The sensory wheel visually represents a comprehensive collection of participants' sensations triggered by tablets. The more samples tested, the more representative the wheel is for a given product; hence, the inclusion of a variety of differently coated tablets and two types of tablet cores (with and without quinine) in this study. During assessment of tasteless tablets, without the influence of a strong taste, participant perception could be focussed on descriptions of texture. In contrast, testing bitter-tasting tablets allowed a more complete

assessment akin to a real-life scenario. A wheel specific for a product category may be useful to train panellists in the variety of attributes associated with that product. It gives a clear “snapshot” of a product’s characteristics. At the same time it informs panellists of related attributes and refines the differences between them (Lawless, Hottenstein and Ellingsworth, 2011) allowing a more precise description of tested samples.

While sensory analysis is objective and does not confirm product palatability, it can identify a spectrum of attributes that dominate the sensory perception and need further evaluation for palatability. For instance, several attributes found in the sensory wheel, like *powdery*, *chemical* or *slimy*, indicate sensory issues associated with tablets with the potential to reduce palatability and subsequent acceptance.

4.4 Limitations of the study

Study limitations include the use of lay participants not trained for sensory analysis. Moreover, some participants were not native English speakers. A limited number of samples in the tablet product category was used, which could decrease the spectrum of vocabulary used.

5 Conclusions

Using sensory analysis, a lexicon to describe the taste, texture and overall impression of a conventional coated tablet was generated. The data collected provides a valuable insight into the sensory experience while taking a tablet, as an exemplar oral solid dosage form. Several of the collected attributes highlighted potential sensory issues with conventional tablets that could affect the acceptability. This knowledge could be used to develop a conventional coated tablet with preferable sensory attributes. The lexicon was built to capture and define the attributes fundamental for the sensory description of tablets. A lexicon brings great value to sensory evaluation as it contains attributes that dominate the sensory perception of the product and unambiguous definitions, and thereby has the potential to inform product development. It also creates a step towards standardisation of sensory assessment and acceptability evaluation. Although a lexicon for tablets is not fully translatable to other OSDFs, these data could steer future sensory analysis of, for example, orally dispersible tablets, films, capsules, or chewable tablets. An important lesson that emerges from this work, is that pharmaceutical sensory research has distinct aims and requirements which differ from food sensory analysis. The approaches and methodologies, therefore, cannot be directly translated from food sciences but need to be adapted to achieve the different goals.

This preliminary study has generated multiple avenues for future research and development. As research in this area grows and evolves, it is expected that some attributes are removed from these tools while others are added. Further research is needed to address the issue of pharmaceutical product references to aid the practical use of lexicons and sensory wheels as standardised tools. In further work the lexicon and sensory wheel will be developed for different formulations, e.g. ODTs or liquids, and the relationships between them will be investigated with regard to palatability and acceptability.

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Table 1 List of formulations used in the study.

| | Formulation | Coating ingredients | Final coating level (w/w)* | Tablet core |
|--------------------------|----------------------------|--|-----------------------------------|--------------------|
| First set of tablets | T_A | - | 0% | Oval, tasteless |
| | T_ACoat-1 | Opadry® 03F mix (HPMC-based) | 3% | Oval, tasteless |
| | T_ACoat-2 | Opadry® EZ Swallow white (HPMC-based + hydrocolloid gum and MCT) | 3% | Oval, tasteless |
| | T_ACoat-3 | Opadry® EZ Swallow white Opadry® EZ Swallow clear (HPMC-based + hydrocolloid gum and MCT) | 3% + 1% | Oval, tasteless |
| Second set of tablets | T_BCoat-4 | HPMC 5, glycerol | 4% | Round, bitter |
| | T_BCoat-5 | Lubritab®, Capmul® MCM, HPMC 5, talcum, titanium dioxide | 4% | Round, bitter |
| | T_BCoat-6 | HPMC 5, xanthan gum, glycerol, talcum, titanium dioxide | 4% | Round, bitter |
| | T_BCoat-7 | Eudragit EPO readymix, titanium dioxide | 4% | Round, bitter |
| | T_BCoat-8 | HPMC 5, Surelease®, glycerol, talcum, titanium dioxide | 4% | Round, bitter |

*as declared by manufacturer

HPMC – hydroxypropyl methyl cellulose

MCT – medium chain triglycerides

Table 2 Frequency of collected participants' comments and attributes.

| | Number of cases | |
|-----------------------------------|-----------------|--------------|
| | First study | Second study |
| All comments | 883 | 730 |
| Valid comments* | 806 | 719 |
| Varying non-repetitive attributes | 128 | 111 |
| Hedonic attributes | 30 | 17 |
| Sensory attributes | 98 | 94 |
| Shared sensory attributes | | 69 |
| Unique sensory attributes | 29 | 25 |

*nonsensical and illegible comments excluded

Table 3 List A: Seventy-four attributes from the first tablet set (T_A) with frequency of occurrence from the second tablet set (T_B); shaded area - List B: forty-one most frequently used attributes (i.e. validated attributes).

| | | | | | | | |
|------------------------|----|---------------------------|----|----------------------|---|-----------------------|---|
| <i>neutral</i> | 35 | <i>dusty</i> | 11 | <i>floury</i> | 6 | <i>gloopy</i> | 1 |
| <i>chalky</i> | 30 | <i>light</i> | 11 | <i>soft</i> | 6 | <i>minty</i> | 1 |
| <i>dry</i> | 26 | <i>plastic</i> | 11 | <i>thick</i> | 6 | <i>pointy</i> | 1 |
| <i>solid</i> | 25 | <i>doesn't fall apart</i> | 10 | <i>pasty</i> | 5 | <i>spongy</i> | 1 |
| <i>chemical</i> | 24 | <i>doesn't melt</i> | 10 | <i>artificial</i> | 4 | <i>aniseedy</i> | 0 |
| <i>movable</i> | 20 | <i>glazed</i> | 10 | <i>gooey</i> | 4 | <i>big</i> | 0 |
| <i>moves easily</i> | 19 | <i>silky</i> | 10 | <i>melts</i> | 4 | <i>disintegrating</i> | 0 |
| <i>rounded</i> | 19 | <i>alkaline</i> | 9 | <i>not movable</i> | 4 | <i>falls apart</i> | 0 |
| <i>bland</i> | 18 | <i>clingy</i> | 9 | <i>shiny</i> | 4 | <i>fizzy</i> | 0 |
| <i>plain</i> | 18 | <i>grainy</i> | 9 | <i>solvent taste</i> | 4 | <i>fluffy</i> | 0 |
| <i>small</i> | 18 | <i>no flavour</i> | 9 | <i>creamy</i> | 3 | <i>furry</i> | 0 |
| <i>matte</i> | 17 | <i>dissolving</i> | 8 | <i>granular</i> | 3 | <i>gelatinous</i> | 0 |
| <i>synthetic</i> | 16 | <i>gluey</i> | 8 | <i>gritty</i> | 3 | <i>glutinous</i> | 0 |
| <i>unnatural taste</i> | 16 | <i>no edges</i> | 8 | <i>not tacky</i> | 3 | <i>large</i> | 0 |
| <i>slick</i> | 15 | <i>doesn't dissolve</i> | 7 | <i>starchy</i> | 3 | <i>mushy</i> | 0 |
| <i>powdery</i> | 13 | <i>mobile</i> | 7 | <i>adherent</i> | 2 | <i>pliable</i> | 0 |
| <i>clean</i> | 12 | <i>slimy</i> | 7 | <i>bumpy</i> | 2 | <i>soggy</i> | 0 |
| <i>hard</i> | 12 | <i>tacky</i> | 7 | <i>loose</i> | 2 | | |
| <i>no taste</i> | 12 | <i>tasteless</i> | 7 | <i>crumbly</i> | 1 | | |

Table 4 Tablet lexicon with sensory attribute definitions. Definitions were based on [1] ISO standard, textbooks [2] Meilgaard et al. (2006), [3] Cambridge English Dictionary (2019) or other lexicon [4] Civille et al. (2010), NA - not available.

| Attribute | Definition | Ref |
|--------------------------|---|------------|
| Texture | | |
| Chalky | Associated with chalk, dry sensation in the mouth | [2] |
| Dry | Free from moisture or liquid, perception of moisture being absorbed by product | [1], [3] |
| Powdery | Amount of fine particles on the surface or as bulk product | [4] |
| Slippery | Degree to which sample slides across the tongue/palate | [2] |
| Adhesiveness | Degree to which the sample adheres to mouth surfaces: lips, tongue, palate, teeth (with increasing intensity level: tacky, clinging, gooey – gluey, sticky – adhesive) | [1] |
| Slimy | Covered in a sticky, smooth, liquid substance, as liquid covering snails | [3] |
| Smooth | Having regular/even surface, lack of lumps or abrasive particles | [2] |
| Rough | Degree of irregularity/unevenness of the product's surface; assessed by rubbing the surface | [4] |
| Granularity | Containing particles/granules detected by assessed by rubbing product between tongue and palate (with increasing intensity and particle size: smooth, gritty, grainy, beady, granular, coarse, lumpy) | [1] |
| Hard | Force required to compress/break the sample | [1] |
| Taste | | |
| Bitter | Innately aversive basic taste sensation characteristic to caffeine | [1] |
| Tasteless | Having no taste, lack of chemical stimulation of taste buds | [3] |
| Aftertaste | Taste or odour sensation that occurs after the elimination of the product | [1] |
| Flavour | | |
| Chemical | Flavour associated with artificial products | NA |
| Visual perception | | |
| Size | Relative description of size (small – large) | [3] |
| Gloss | The tendency of a surface to reflect light (shiny – matte) | [1] |
| Change-of-state | | |
| Dissolving | Degree to which the core of the sample dissolves in contact with saliva | NA |
| Disintegrating | Degree to which the core of the sample breaks up into small parts in contact with saliva | NA |
| Solid | Keeping a clear shape, object without any spaces or holes, integrity of shape | [2] |
| Other | | |
| Neutral | Lack of dominant or noticeable characteristics | [1] |

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Cambridge English Dictionary, 2019.

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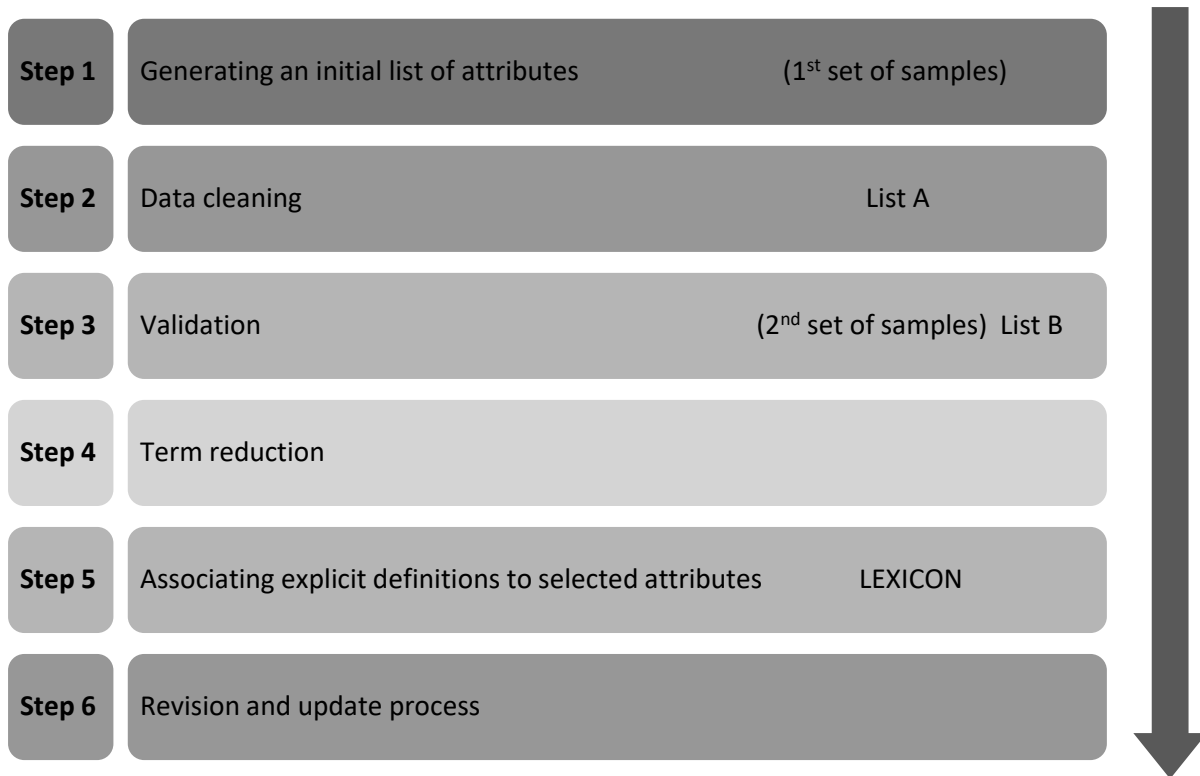


Figure 1 Process of building a lexicon for tablets; Step 6 is a prospective process (not reported in this preliminary study).

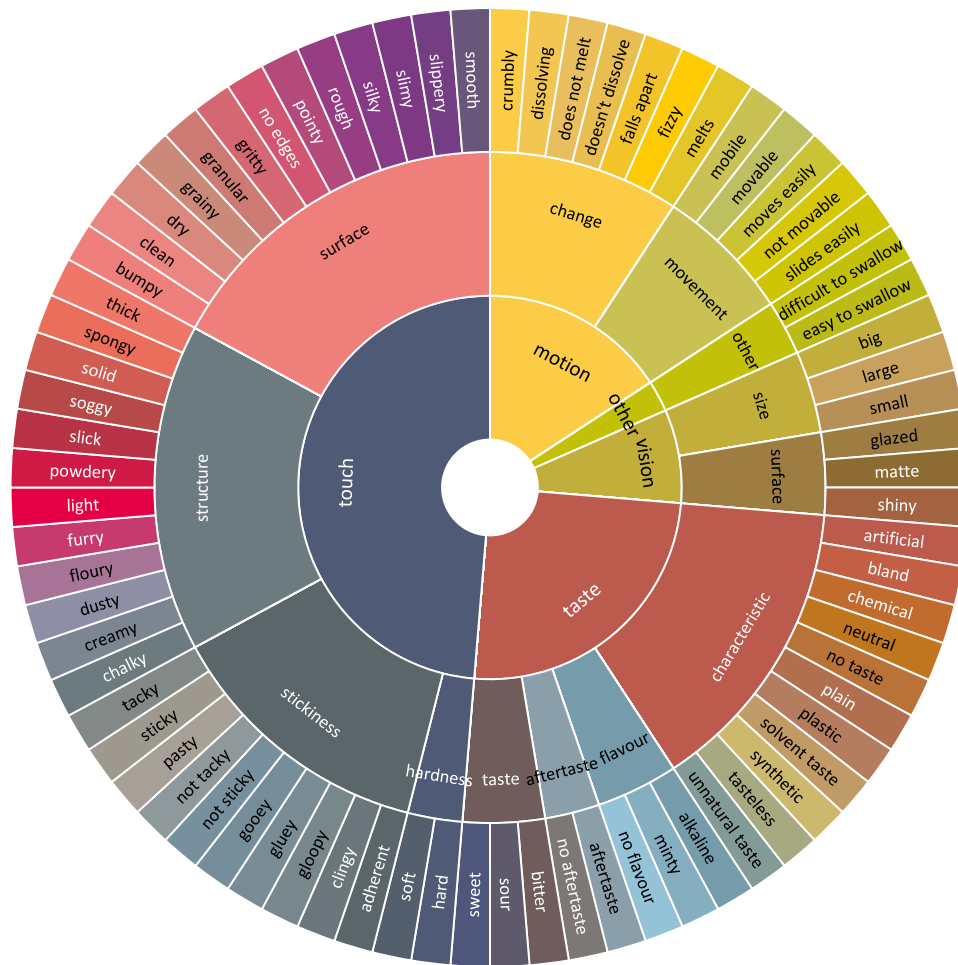


Figure 2 Tablet sensory wheel.

Appendix A

Participant demographics.

| | First sensory panel (n=83) | | Second sensory panel (n=52) | |
|--------------------|-----------------------------------|-------------|------------------------------------|-------------|
| | Frequency | Percent [%] | Frequency | Percent [%] |
| Gender | | | | |
| Male | 34 | 41.0 | 19 | 36.5 |
| Female | 49 | 59.0 | 33 | 63.5 |
| Age (years) | | | | |
| <24 | 10 | 12.0 | 11 | 21.2 |
| 25-34 | 13 | 15.7 | 29 | 55.8 |
| 35-44 | 11 | 13.3 | 5 | 9.6 |
| 45-54 | 7 | 8.4 | 5 | 9.6 |
| 55-64 | 10 | 12.0 | 1 | 1.9 |
| >65 | 32 | 38.6 | 1 | 1.9 |

Appendix B

Frequency of the attributes included in the sensory wheel and their definitions. Definitions were based on [1] ISO standard (International Organization for Standardization, 2008), textbooks [2] Meilgaard et al. (2006), [3] Cambridge English Dictionary (2019) or other lexicons [4] Civile et al. (2010), [5] Kim et al. (2013) NA - not available.

| Attribute | Number of participants who used the attribute (n=135) | Number of tablets described with the attribute (n=9) | Total number of uses of the attribute | Definition | Reference |
|----------------------|---|--|---------------------------------------|--|-----------|
| adherent | 3 | 3 | 3 | Level of adhesiveness, i.e. degree to which the sample adheres to mouth surfaces: lips, tongue, palate, teeth (with increasing intensity level: tacky, clinging, gooey – gluey, sticky – adhesive) | [1] |
| aftertaste | 6 | 5 | 8 | Taste or odour sensation that occurs after the elimination of the product | [1] |
| alkaline | 9 | 4 | 11 | flavour produced by dilute aqueous solutions of basic substances, i.e. pH > 7,0, such as sodium hydroxide | [1] |
| artificial | 5 | 4 | 6 | Flavour associated with artificial products | NA |
| big | 2 | 3 | 3 | Relative description of size, large (opposite to small) | [3] |
| bitter | 14 | 9 | 18 | Innately aversive basic taste sensation characteristic to caffeine | [1] |
| bland | 17 | 8 | 24 | With a low level of flavour | [1] |
| bumpy | 5 | 3 | 5 | Having not smooth, uneven surface | [3], [4] |
| chalky | 40 | 9 | 53 | Associated with chalk, dry sensation in the mouth | [2] |
| chemical | 21 | 7 | 27 | Flavour associated with artificial products | NA |
| clean | 13 | 7 | 17 | property of leaving no lingering mouth after-feel once swallowed | [1] |
| clingy | 8 | 6 | 10 | Level of adhesiveness, i.e. degree to which the sample adheres to mouth surfaces: lips, tongue, palate, teeth (with increasing intensity level: tacky, clinging, gooey – gluey, sticky – adhesive) | [1] |
| creamy | 4 | 4 | 4 | Level of viscosity, i.e. degree of resistance to flow (with increasing intensity: fluid, thin, creamy, thick) | [1] |
| crumbly | 5 | 2 | 5 | Level of fracturability, i.e. degree to which the sample breaks into pieces under force (with increasing intensity level: cohesive, crumbly, crunchy, brittle, crispy, crusty, pulverulent) | [1] |
| difficult to swallow | 2 | 1 | 2 | Amount of effort required to swallow a sample | [5] |
| dissolving | 30 | 5 | 37 | Degree to which the core of the sample dissolves in contact with saliva | NA |
| does not melt | 12 | 6 | 12 | Opposite to melting | NA |

| | | | | | |
|------------------|----|---|----|--|----------|
| doesn't dissolve | 15 | 8 | 21 | Opposite to dissolving | NA |
| dry | 25 | 8 | 35 | Free from moisture or liquid, perception of moisture being absorbed by product | [1], [3] |
| dusty | 10 | 6 | 13 | Covered in dust, associated with dirt, soil | [3] |
| easy to swallow | 10 | 4 | 13 | Amount of effort required to swallow a sample | [5] |
| falls apart | 3 | 1 | 3 | Prone to fracturability, i.e. breaking into pieces | NA |
| fizzy | 3 | 1 | 3 | Having bursting bubbles, effervescent | [1] |
| floury | 9 | 4 | 9 | Covered in flour, having a taste or feel like flour | [3] |
| furry | 2 | 1 | 2 | Covered in fur, made from soft material like fur | [3] |
| glazed | 8 | 5 | 11 | Covered with a smooth, shiny coating | [3] |
| gooepy | 2 | 2 | 2 | Level of adhesiveness - thick or sticky | [3] |
| gluey | 10 | 6 | 12 | Level of adhesiveness, i.e. degree to which the sample adheres to mouth surfaces: lips, tongue, palate, teeth (with increasing intensity level: tacky, clinging, gooey – gluey, sticky – adhesive) | [1] |
| gooey | 5 | 4 | 5 | Level of adhesiveness, i.e. degree to which the sample adheres to mouth surfaces: lips, tongue, palate, teeth (with increasing intensity level: tacky, clinging, gooey – gluey, sticky – adhesive) | [1] |
| grainy | 10 | 7 | 13 | Level of granularity, i.e. containing particles/granules detected by assessed by rubbing product between tongue and palate (with increasing intensity and particle size: smooth, gritty, grainy, beady, granular, coarse, lumpy) | [1] |
| granular | 4 | 4 | 4 | Level of granularity, i.e. containing particles/granules detected by assessed by rubbing product between tongue and palate (with increasing intensity and particle size: smooth, gritty, grainy, beady, granular, coarse, lumpy) | [1] |
| gritty | 6 | 5 | 6 | Level of granularity, i.e. containing particles/granules detected by assessed by rubbing product between tongue and palate (with increasing intensity and particle size: smooth, gritty, grainy, beady, granular, coarse, lumpy) | [1] |
| hard | 20 | 7 | 24 | Level of hardness, i.e. force required to compress/break the sample (with increasing intensity: soft, firm, hard) | [1] |
| large | 8 | 4 | 11 | Relative description of size (opposite to small) | [3] |
| light | 9 | 5 | 12 | Low level of density | [1] |
| matte | 16 | 6 | 18 | Lack of the tendency of a surface to reflect light (opposite to shiny) | [1] |
| melts | 9 | 5 | 10 | Level of chewiness, i.e. work required to masticate solid product (with increasing intensity: melting, tender chewy, tough) | [1] |
| minty | 3 | 2 | 3 | With a characteristic taste or smell of mint (herb with strong, fresh flavour) | [3] |
| mobile | 7 | 7 | 10 | Moving freely | [3] |
| movable | 13 | 5 | 22 | Able to be moved | [3] |
| moves easily | 26 | 8 | 36 | Amount of effort required to move a sample | NA |

| | | | | | |
|---------------|----|---|-----|--|----------|
| neutral | 41 | 9 | 62 | Lack of dominant or noticeable characteristics | [1] |
| no aftertaste | 5 | 5 | 5 | Lack of taste or odour sensation that occurs after the elimination of the product | [1] |
| no edges | 7 | 6 | 9 | Lack of or difficult to perceive edges | NA |
| no flavour | 8 | 5 | 10 | Lack of flavour, i.e. chemical and trigeminal stimulation | [1] |
| no taste | 20 | 6 | 27 | Lack of chemical stimulation of taste buds | [3] |
| not movable | 6 | 6 | 10 | Opposite to movable | NA |
| not sticky | 4 | 2 | 5 | Lack of stickiness | NA |
| not tacky | 4 | 3 | 4 | Lack of tackiness | NA |
| pasty | 6 | 5 | 7 | Level of gumminess, i.e. degree of effort required to disintegrate the product (with increasing intensity: short, mealy, pasty, gummy) | [1] |
| plain | 16 | 7 | 20 | Simple, with nothing added | [3] |
| plastic | 9 | 8 | 15 | With characteristic of or associated with plastic – artificial pliable material | [3], [4] |
| pointy | 2 | 2 | 2 | Shaped into a point | [3] |
| powdery | 36 | 9 | 41 | Amount of fine particles on the surface or as bulk product | [4] |
| rough | 36 | 6 | 44 | Degree of irregularity/unevenness of the product's surface; assessed by rubbing the surface | [4] |
| shiny | 5 | 4 | 6 | The tendency of a surface to reflect light (opposite to matte) | [1] |
| silky | 13 | 5 | 15 | Soft and smooth | [3] |
| slick | 12 | 4 | 16 | Having a smooth, shiny surface | [3] |
| slides easily | 3 | 2 | 3 | Amount of effort required to move over the surface | [3] |
| slimy | 16 | 8 | 20 | Covered in a sticky, smooth, liquid substance, as liquid covering snails | [3] |
| slippery | 43 | 6 | 63 | Degree to which sample slides across the tongue/palate | [2] |
| small | 12 | 6 | 19 | Relative description of size (opposite to large) | [3] |
| smooth | 65 | 7 | 117 | Having regular/even surface, lack of lumps or abrasive particles | [2] |
| soft | 11 | 5 | 11 | Level of hardness, i.e. force required to compress/break the sample (with increasing intensity: soft, firm, hard) | [1] |
| soggy | 2 | 1 | 2 | Lack of crispiness, i.e. no force is needed to break or fracture a product; wet and soft | [2], [3] |
| solid | 27 | 8 | 35 | Keeping a clear shape, object without any spaces or holes, integrity of shape | [2] |
| solvent taste | 5 | 3 | 5 | Flavour associated with a solvent or flavour carrier; reminiscent of ethanol or vodka | [4] |
| sour | 4 | 4 | 4 | Basic taste sensation, generally due to presence of organic acids | [1] |
| spongy | 2 | 2 | 2 | Soft and able to absorb or having already absorbed a lot of liquid | [3] |

| | | | | | |
|-----------------|----|---|----|--|-----|
| sticky | 46 | 9 | 53 | Level of adhesiveness, i.e. degree to which the sample adheres to mouth surfaces: lips, tongue, palate, teeth (with increasing intensity level: tacky, clinging, gooey – gluey, sticky – adhesive) | [1] |
| sweet | 17 | 5 | 17 | Basic taste sensation, characteristic to sucrose or aspartame | [1] |
| synthetic | 12 | 6 | 17 | Flavour associated with artificial products | NA |
| tacky | 10 | 6 | 13 | Level of adhesiveness, i.e. degree to which the sample adheres to mouth surfaces: lips, tongue, palate, teeth (with increasing intensity level: tacky, clinging, gooey – gluey, sticky – adhesive) | [1] |
| tasteless | 26 | 7 | 33 | Having no taste, lack of chemical stimulation of taste buds | [3] |
| thick | 7 | 4 | 7 | Level of viscosity, i.e. degree of resistance to flow (with increasing intensity: fluid, thin, creamy, thick) | [1] |
| unnatural taste | 12 | 5 | 16 | Flavour associated with artificial products | NA |

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Appendix C

Transcription of participants' comments. Each line represents description of a single participant.

T_A

rough texture, slightly minty taste

sticky, rough

immediately started dissolving and sticky to the tongue

dissolves, pleasant, rough

nasty, chalky, rough

tasty, starting to dissolve

powdery, chalky texture

soggy, chalky, slimy

rough, sticky, tastes a little

unpleasant, chalky, dry

disgusting taste, coating melted so quickly (fastly), stays in place

fizzy, like baking powder, soft

stronger flavour, crumbly, powdery

rough, sticky, sweet

powdery, rough, dissolving

chalky, clingy

powderish, melting in the mouth

powdery, aftertaste

melted in the mouth, was not as expected, felt like there was no coating on the tablet

dry, a bit powdery at the end of the time/slimy, a bit fizzy at the end of the time

powdery, sticky

sticky, rough, weight loss

soft, chalky, difficult to move around

tasteless

evaporated on tongue, rough, powdery

rough, sticky

powdery, dry

the test not good, stay in place, become pices/powder

rough, dry, unpleasant

chalky, powdery, dissolves

dry, tacky, dissolving

dissolvable, not nice but not bad

chalky, melts

leaves a taste in the mouth, very rough on the palate, not pleasant

tacky, powdery, rough

rough, not easy to chew or swallow, sticky

dissolves quickly in mouth, sweet, strange, large

dissolves quickly, feels rough initially, difficult to swallow, 2 attempts with water

milky, fluffy, granular

powdery, tasted neutral, adherent

sticky, unpleasant texture

coating dissolves, sticky, stimulated saliva

initially dry, sweetish after a while, slightly powdery

felt as it would totally dissolve in the mouth, very unpleasant, quite large

powdery, dissolving slowly, comfortable

rough, alkaline, powdery

felt as though it was dissolving slowly, acceptable, gentle

fizzy, breaks apart, odd

terrible

mushy, sticky, ugh

chalky, dissolves quickly, unpleasant taste, very hard to move in mouth, horrible

very chalky, dissolves quickly, no aftertaste

rougher surface, sticks to the tongue, taste less pleasant

very chalky, alkaline taste, very strange unpleasant texture, melted in mouth but powdery also, very sticky

tablet felt softer as it was going to dissolve, tablet dissolved much more quickly than previous two, tablet was softer feel in mouth

tacky, disintegrated, yuk

dusty, crumbly, bitter

sticky, sweetish, dissolving

powdery, dissolves in mouth, sticky to swallow

nasty, glutenous, powdery

chalky, powdery

floury, sticky, resistant

chalky, rough, unpleasant

rough, falls apart easily, slightly sweet

rough, sticky, starts to dissolve

big, very sticky/powdery, bad/strong taste, but not bitter

dissolves, chalky, sticky

sticky, furry, uncomfortable

chalky, powdery, sticky

tacky, insolvent, quite a pleasant taste

large, dissolving, rough

loose, rough, uncomfortable

bad texture, slightly minty, soggy

dusty, slightly sticky, not too large

rough, pleasant taste

furry, gelatinous, large

comfortable, rough (ish), crumbly

I didn't like this one, horrible, rough, felt like it was dissolving

floury, sweet, unpleasant

spongy, soft, Pliable

crumbles, powdery, unpleasant

unpleasant, sweet, tastes like flour

T_ACoat-1

smooth

started to feel rough after 15s and could taste

solvent like taste which developed after few seconds, then powdery gritty texture after 20s

sticky

mealy, smooth, big

neutral

smooth, slightly sticky, nice

smooth, moves easily, slight taste

smooth, pleasant, easy

stick in the mouth, doesn't move easily, taste is not good

tasteless, sticky, hard, didn't begin to fall apart

chemical, lingering, hard

smooth, easy, neutral

shiny, plain, slippery

unpleasant taste, texture and aftertaste

feels more sticky than others

the coating seemed somewhat plastic feeling in the mouth, started to feel like melting in second 9

smooth

weird taste

slippery, no weight loss, smooth

smooth, than slight granulation, should swallow easily

swallowable, tastes bad

glue textured, stodgy

acceptable, smooth

smooth, comfortable

bad test, hard, no easy, slips

smooth, pleasant, slippery

smooth, slippery, chemically

powdery, pleasant, dry

sticky, dissolves a bit, broke in half and disolves

gooey, aftertaste, smelly

very similar to 630, smooth texture, easy to move around

sticky, tacky

slippery, no taste, easy suck

neutral taste, slips but starts to dissolve slowly in the mouth, still possible to swallow

sweet, becomes more difficult to swallow as coating dissolves, didn't seem to swallow completely, 2 attempts with water

slipps, pleasant, solid

distasteful - tasted plasticky, smooth at first but it very quickly becomes unpleasant, almost starchy, starchy

an object in the mouth, smooth, slippery

no taste, didn't dissolve

smooth, quite large, not unpleasant to taste

ok, silky, bland

sticky, untasty, silky

tasteless until slight hint of mint when spat out, didn't feel it would ever dissolve, would be easy to swallow

grainy, bitter, sticky

slimy, bitter, smooth

starts smooth but becomes sticky, chalky after 7-8s, taste not bad until 8+ seconds when it becomes more pronounced

leaves an aftertaste, not pleasant, slimy texture

initially smooth then rougher, moves around easily, not as palatable as 531

very unpalatable taste, artificial, very smooth until first layer dissolves, was also very sticky, left a chalky residue on the tongue which was also unpleasant

best to take out of 4, slightly rough, strange taste

smooth, sticky, unpleasant

smooth, cardboardy, pleasant

neutral, easy, solid

pleasant, large, stickier

smooth, clean

slippy then chalky, unpleasant

tacky, resistant, neutral taste

smooth, neutral taste, easy

a little slippery/slimy, sticky, smooth

smooth, tasteless, neutral

light powder, tastes odd but not bad, rounded

soft, sticky yet not sticky, chalky

comfortable, mild taste, smooth

smooth, slippy, tasteless

non descript, just a tablet!, moves around palate, not unpleasant, no taste at all

unpleasant, synthetic

smooth, easy, bland

easy, no taste, smooth

slightly grainy, not too large, manageable

feels a bit rougher the longer it stays on tongue

sweeter than others, comfortable, more unnoticeable

smooth, neutral, pleasant

smooth, silky, no aftertaste

smooth, towards end of 10 seconds felt it might dissolve, a little sticky

glue like, unpleasantly sticky, obtrusive

solid, smooth, resistant

milky, bitter, sticky

T_ACoat-2

slight chemical taste

smooth, slippery, palatable

poor, sticky

bland, big

slightly sour

smooth, slippery, pleasant

smooth, moves easily if I tried, no flavour

average

doesn't taste, slip easily, smooth

almost sweet taste, smooth

aniseedy, solid (didn't crumble), pleasant

smooth, easy, clean

slippery, rough, uninvasive

sweeter

neutral, slippery

no taste, feels like some of coating left on roof of mouth

slippery, felt coating was stronger, did not melt in the mouth

a little dry, a little bumpy

slippery, no weight loss, smooth

comfortable, sticks, probably ok

smooth, unnatural taste, slippery

pleasant, slides easily, quite acceptable

comfortable, smooth

easy to slips, good test, hard

pleasant, creamy, smooth

smooth, neutral, slippery

smooth, acceptable, tasteless

large,unweidly, rough the longer in the mouth

aftertaste

smooth mostly, easy to move around, tasteless

moveable, nothing descriptive to say

smooth, easy to swallow, no taste

neutral, no taste, slippery, smooth, easy to swallow with water

smooth, doesn't dissolve, swallows easily

slimy, unplesant

smooth, passes easily in the mouth, textureless

fine, smooth

an object in the mouth, moves easily against the palate, does not stick

no taste, didn't dissolve in mouth

a bit gritty, neither pleasant or unpleasant, not too smooth

slightly sweet, smooth, slippery

sticky, slimy, slightly bitter

tasteless, hard, didn't think it would ever dissolve if I couldn't swallow it

slightly grany but not distracting, chemically taste, movebale

rough, chalky, sweet

fairly smooth with slight bumpy texture but pleasant enough, slips around fairly easily in mouth, taste not offensive, after 8s becomes very slightly chalky

thick, not unpleasant, swallowable

neutral taste, very slippery, felt it would be easy tgo swallow

very smooth and slippery, not sticky at all, not nice taste, artificial and bitter
tablet not too rough, table did not stick at all, slightly rough
slippery, tasteless, ok
dry feeling, easy to move around, no taste
preferred, easy, tasteless
menagable, slightly rough, neutral flavour
solid, smooth, clean
hard, bland
surface matt, mobile, tasteless
slightly rough, bit of taste, neutral
smooth, slightly chalky, slightly salty, not unpleasant
slightly rough, ok, slightly sweet
smooth, small, good, not unpleasant
rough, not dissolve
comfortable, tasteless, free-moving
smooth, slippery, tasteless
not tacky, slippery, not unpleasant, had no taste what so ever (or I have lost my sense of taste!)
smooth, plastic
smooth, comfortable, tasteless
antiseptic taste, unpleasant
solid, neutral, slightly large
neutral taste
very easily moves
comfortable, neutral, not unpleasant
rough on the tongue, slght aftertaste, moved around mouth easily
smooth, slippery, easy to move
slippery, uncomfortable, slimy
powdery outer coating, hard, slimy
rough, tasteless, more on a pleasant side

T_ACoat-3

normal
smooth, slippery, pleasant
pasty
silky smooth, slippery, pleasant feel
slippery, tasteless, imagine easy to swallow
smooth, pleasant, easy
coating does not melt easily, taste is acceptable, slips easily and quite smooth
smooth, almost grainy, with time, with time+mix with saliva, tasteless
paste like taste, smooth, easy
smooth, slippery, neutral
smooth, slippery, uninvasive
holds together
quite unusually sweet taste for a tablet

felt a slimy in mouth towards end

smoothish

smooth

smooth, slippery, no weight loss

slipps easily, not uncomfortable, taste improvement

slippery, smooth, taste bit unpleasant

tasteless, slippery

smooth, didn't cause me any problems

smooth

hard, stay in place, pleasant

smooth, pleasant, slippy

smooth, slippery, neutral

accetable, fairly smooth, ok

large, solid, no too bad

easy, ok, large

very smooth, slides easily, no aftertaste

slippy, smooth, shiny

slippery, no taste, easy to swallow

neutral taste, no taste, easy to swallow, doesn't dissolve, slippery

smooth, doesn't dissolve, swallows easily

coating sticks to the tongue, unpleasant, slimy

smooth, tablet became less smooth after approximately 20s, easy to take, fine

smooth, nice, I wish all tablets are like this product

slippery, smooth, not sticky

no taste, didn't dissolve

no taste at all, very slippy, no at all sticky

smooth, fairly slippery, bland taste

smooth, hard, tasteless

hard, tasteless, not sure if would have dissolve if I couldn't swallow it

neutral, slippery, plain

smooth, slightly bumpy, slippery

comfortable

slightly rough, a bit gloopy, slightly gritty texture

glue like, slimy, not pleasant

tasteless, comfortable balance between smooth+stickiness

smooth, strange taste, chalky

smoother than previous, not much different than 299, like previous

smooth, ok, slight taste

smooth, not too big, easy to suck

neutral, slippery, hard

smooth, slippery, pleasant neutral taste

clean, solid, pleasant

bland, smooth

smooth, mobile, tasteless

slightly rough, easy swallowable, tasteless

super smooth, very slippery, slightly salty/not unpleasant

smooth, slippery, neutral

slightly bitter, bad taste, slippery, average size feeling in the mouth

hard, sweet

smooth, tasteless, free-moving

super smooth, slick, nice

slippy, slides around, slight taste but not unpleasant

smooth, plastic

sticky, smooth, comfortable

odd taste after a few seconds, quite rough for a tablet

solid, mobile, not intrusive

slippery, pleasant taste

powdery, large, indigestible

neutral, not unpleasant, ok

weird aftertaste, only very slight though, silky, smooth

tasteless, didn't start to dissolve until right at end of time, smooth

light, feels glazed, pointy

slimy outer surface, solid, dry aftertaste

a bit bitter, slips easily, didn't feel edges of this tablet

T_BCoat-4

moves easily, shiny, clean

movable, glazed, light

unambiguous, slimy, silky

neutral, okay, strong taste, slick, moves easily

not tacky, silky, melts, the coating totally dissolved by the end of 5s

bitter, quite sticky

dry, absorbant, sour

nice textural, in the beginning not bitter

rounded, hard, dense

slick, clean, rounded

round, unnatural taste, hard

chemical, grainy, solvent taste

dissolving, unnatural taste, granular

neutral, solid, small

edgy, smushy, flat

does not melt, chalky, chemical

chemical, alkaline, gooey

shiny, slick, no flavour

solvent taste, synthetic, starchy

bland, gluey, moves easily

slimy, glazed, no edges

chalky, powdery, dissolving

synthetic, no edges, matte,
movable, unnatural, light
chemically, doesn't fall apart, not tacky
dry, clingy, hard
synthetic, gooey, pasty
chalky, small, 'like paracetamol'
unnatural taste, chalky, dissolving
chemical, slimy, plastic
plain, smooth, hard
dissolving, bland, pasty
alkaline, movable, rounded
chalky, solid, dry
doesn't dissolve, small, rounded
moves easily, no edges, slick
rounded, movable, mobile
plastic, synthetic, rounded
chemical, matte, tacky
silky, pleasant, clean
gooey, thick, does not melt
matte, rounded, does not melt
tasteless, neutral, light
adherent, alkaline, gluey
dusty, chalky, unnatural taste
aftertaste better
alkaline
smooth, chalky, silky
matte, smooth, strange taste, glazed

T_BCoat-5

moves easily, bland, gelly like, average small sized tablet
moves easily, neutral, glazed
obtrusive, nasty, smooth
nice, smooth, surprising bad aftertaste, small slick, doesn't fall apart
clean, plain, bland, dissolution of the tablet left greasy feeling on the tongue
neutral feelings!
pleasant, moveable
little bitter, neutral
bland, chalky, light
bland, neutral, solid
light, neutral, doesn't dissolve
silky, plain, doesn't fall apart
movable, no taste, solid
small, neutral, mobile
small, no taste, soft to touch

moveable, no edges, no flavour

neutral, rounded, plain

glazed, silky, no flavour

movable, neutral, solid

mover easily, slick, glazed

chalky, powdery, dry

plain, simple, small

movable, neutral, starchy

light, pleasant, movable

small, tasteless, clingy

no flavour, doesn't dissolve, soft

solid, clean, bland

neutral, solid, small

solid, matte, tasteless

powdery, plastic, chemical

bland, neutral, no taste

it seems neutral, with no flavour, with no taste

does not melt, moves easily, small

bland, movable, no taste

solid, doesn't fall apart, hard

rounded, neutral, movable

synthetic, plastic, solid

neutral, plain, light

gritty, unpleasant, clingy

clean, plain, solid

sweet, dusty, powdery

no taste, no flavour, clean

neutral, silky, matte

not a problem

bland, fake, plastic, didn't enjoy this tablet

no taste, does not melt, small

feels easy to swallow

no taste, pasty

smooth, clean, bland

slippery, extremely small aftertaste, slight stick, generally plain

T_BCoat-6

silky, movable, neutral

glazed, movable, solid

overt, tough, bad

dry, smooth, neutral, bit taste, gooey, slick

synthetic, creamy, tacky, after the dissolution of the coating (at the end of 10 secs) the stickiness of the core was left

started to like it at some point!

smooth

pleasant, nice, minimal bitter

easy

clean, soft, lubricated

no taste, slick, doesn't dissolve

neutral, small, rounded

dissolving, dusty, floury

unnatural taste, medicine-like

mobile, silky, chemical

bitter, dry, synthetic

moves easily, neutral, does not fall apart

moves easily, solid, rounded

slick, slimy, moves easily

movable, soft, clean

clingy, not movable, gluey

slimy, silky, smooth

soft, neutral, movable

slick, chemical, unnatural taste

light, moves easily, tasteless

plastic, slick, small

shiny, rounded, slick

chalky, matte

moves easily, slick, coated

starchy, pasty, moves easily

moves easily, doesn't fall apart, chemical

smooth, moves easily, quinine tasting

bland, chemical, synthetic

light, small, solid

artificial, rounded, moves easily

neutral, bland, tasteless

no taste, no edges, neutral

movable, mobile, shiny

plastic, synthetic, rounded

greasy, melts, slick

sticky, grainy, solid

gluey, melts, clingy

synthetic, unnatural taste, dry

no taste, no flavour, neutral

glazed, doesn't fall apart, plastic

not as bad as the others

clean, smooth, tasteless

strong bitter aftertaste

minimal taste

powdery, plain, sour

tasteless, slick, not much flavour, generally slippery, no strong bitter aftertaste

T_BCoat-7

plain, not movable, matte

dry, chalky, light

unpleasant, unassuming, chalky

unsmooth, bitter, slow, chalky, doesn't move easily, hard

synthetic, tacky, grainy

a bit sour maybe as well?

dry

dry, bad surface

stick, glued down

chalky, powdery

papery, dry, unnatural taste

neutral, solid, bland

chalky, bumpy, alkaline

dusty, chalky, bitter, artificial medicine-like taste

little tangy, hard

very firm, gluey, has sharp edges (pointy)

floury, loose, alkaline

chalky, doesn't dissolve, dusty

solid, light, doesn't dissolve

clingy, plain, neutral

does not melt, artificial, moves easily

dusty, hard, chalky

matte, dry, plastic

chalky, no edges, thick

easy, no flavour, mobile

chalky, matte, gluey

plain, dry, tacky

bland, neutral, plain

rough, neutral, dusty

pasty, floury, matte

powdery, no taste, not tacky

gooey, slimy, grainy round edges

a bit chalky, dry, plain

dry, matte, solid

granular, creamy, chalky

gritty, a little dry, small

matte, grainy, bumpy

solid, doesn't dissolve, chalky

matte, hard, solvent taste

spongy, unnatural taste, chemical

powdery, sticky, clingy

dry, neutral, plain

powdery, solvent taste, floury

slightly bitter, clingy, does not melt

chalky, floury, powdery
horrible
matte, dry, gritty
aftertaste not bad
taste like a cleaning product, alkaline, unnatural, chemical
plain, neutral, solid
immediate unnatural taste, slightly sticky, bit unpleasant

T_BCoat-8

not movable, plain, neutral
glazed, movable, solid
abusive, sticky, permcting
nice, smooth, good, rough, mobile, doesn't fall apart
little bit grainy, chalky, dry
bitter, but not terribly
semi-dry, slightly sticky
bad aftertaste, good surface
neutral, not much aftertaste
tacky, crumbly, absorbent
unnatural taste, chemical, bland
doesn't melt, clean, neutral
rounded, chemical, alkaline
powdery, unnatural taste, chemical
neutral, dry, tangy
chemical taste, smooth, slippery
gluey, slimy, melts
chalky, tacky, does not melt
alkaline, unnatural taste, doesn't melt
solid, no edges, movable
bad taste, grainy, unpleasant
dusty, strong flavour, dry
dry, unnatural taste, dissolving
synthetic, hard, glazed
unnatural, thick, movable
chemically, small, doesn't fall apart
minty, dry, small
adherent, thick, chemical
matte, chalky, dusty
grainy, chalky, powdery
dissolving, chemical, plastic
hard, mobile, chemical
dissolving, granular, thick
moves easily, no edges, soft
solid, synthetic, bland

hard, solid, slightly drying

rounded, loose, creamy

doesn't fall apart, chalky, solid

plastic, synthetic, rounded

synthetic, unnatural taste, tacky

clingy, rough, grainy

matte, chemical, gluey

chalky, powdery, dusty

slightly bitter, plain, clean

dusty, chemical, synthetic

dry, thick, artificial, tastes like paracetamol

bitter aftertaste

bland, unnatural

unnatural taste, floury, sharp

sticky, slightly bitter, slightly chemical
