Time-intensity measurements of refreshing effect in mint chewing gum and refreshing tablets

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Most sensory methods are single point measurements (time as a dimension is ignored)
Time–intensity (T–I) method: what is being measured?

Idealized T-I response curve and information derived

- maximum intensity
- time to max intensity
- area under the curve
- total duration
- delay time

What is being measured in a T–I method?
### Peculiarities of Oral Sensations: Food vs. Refreshing Products

<table>
<thead>
<tr>
<th>Features</th>
<th>Food</th>
<th>Refreshing products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeping time</td>
<td>&lt; 60 sec</td>
<td>300-600 sec</td>
</tr>
<tr>
<td>After-effect</td>
<td>moderate, various</td>
<td>very strong, long-lasting</td>
</tr>
<tr>
<td>Main stimuli</td>
<td>odorants, tastants</td>
<td>irritants</td>
</tr>
<tr>
<td>Importance of T-I characteristics</td>
<td>moderate</td>
<td>very high</td>
</tr>
</tbody>
</table>

Above shall be taken into consideration when looking for appropriate sensory method for refreshing products.
The term has been introduced in nineties of last century instead of earlier „common chemical sense”

Chemesthesis is a sensory system responsible for irritating sensations as:

⇒ burn (of capsaicin or hot paprika)
⇒ sting (of CO₂ in carbonated beverages)
⇒ cooling (of menthol or peppermint)

Stimulation

Capsaicin → heat-sensitive pain fibers
Menthol → cold fibers + pain fibers
Chemesthesis because its basis in skin „temperature and pain system” has very different characteristics as compared with olfactory and gustatory sensations.

Three important features:

⇒ Qualitative variety (concentration-dependent)
⇒ Spatial heterogenity (great uneveness in sensitivity of oral, pharyngeal and nasal mucosa)
⇒ Temporal properties (time-delay, long-lasting, long after-effect)
How to measure time – related changes in such peculiar material as refreshing food and non food products?
checking the applicability of available methods and procedures to characterize sensory properties of refreshing products and their time-related changes
MATERIALS

3 chewing gums of different refreshing strength
- „extra strong”
- „fresh mint”
- „spearmint”

3 refreshing tablets (as above)
- „winter frost”
- „origin”
- „spearmint”
Two approaches of T-I measurements were compared:

⇒ **Conventional T-I procedure (CTI)** in which intensity of four attributes were traced and recorded over time sequentially, each attribute separately.

⇒ **Developed modified procedure, named „Time-Related Profiling” (TRP),** where all four attributes were evaluated and recorded as simplified „profile” in pre-determined time intervals, on given to panelists acoustic signals.

All other procedural details, as:
⇒ order of attributes evaluation
⇒ sample holding time
⇒ overall time of intensity tracing

were in both approaches the same.
7-member sensory panel well-trained and experienced in sensory methods, including T-l

Panel of „multi-product” experience - but no earlier experience in refreshing products
Development of standardized procedure of T-I measurement in refreshing products

⇒ Defining „refreshing effect”

⇒ Estimation of intensity range for attributes

⇒ Estimation of overall refreshing feeling duration

⇒ Checking effectiveness of neutralizers
Panel: getting familiar with the refreshing products

Initial discussion + informal tasting to get agreement what it is „refreshing effect”:

⇒ Intensity of cooling?
⇒ Intensity and duration of cooling?
⇒ More complex feeling? Which attributes?
Refreshing effect

Complex sensation combining mint flavour, bitterness/pungency and cooling, its strength and duration, „rounded” by some sweetness

Order of attributes occurrence:

sweet
mint
bitter/pungent
cooling
RESULTS

Conventional T-I (CTI) procedure (example of individual curve)

Panelist: GWZ
chewing gum (mint)
After analyzing individual results and discussion with the panelists it has been stated that conventional T-I (CTI) method appeared to be hardly applicable to refreshing products because:

- psychological difficulty to focus attention on intensity changes over so long time reported by panelists (resulting very high within subject variability)
- long lasting cross-adaptation effect, which may differently bias consecutive T-I measurements
- practical non-feasability (extremely long time of data collection)
RESULTS

Time-Related-Profiling (TRP) procedure - chewing gum
Time-related profiles (TRP) mint-flavoured chewing gum

- discrete measurements

"frost"

"spearmint"
Time-course intensity of main sensory attributes in mint-flavoured chewing gum

**"original"**

- sweet
- mint
- bitter-pungent
- cool

**"frost"**

- sweet
- mint
- bitter-pungent
- cool

**"spearmint"**

- sweet
- mint
- bitter-pungent
- cool
Profiles of main sensory attributes in mint-flavoured chewing gum "original"

Sample in the mouth

- **30 s**
  - Sweet: 8
  - Cool: 2
  - Mint: 8
  - Bitter-pungent: 2

- **2 min**
  - Sweet: 8
  - Cool: 2
  - Mint: 8
  - Bitter-pungent: 2

- **3 min**
  - Sweet: 8
  - Cool: 2
  - Mint: 8
  - Bitter-pungent: 2

After sample removal

- **12 min**
  - Sweet: 8
  - Cool: 2
  - Mint: 8
  - Bitter-pungent: 2

- **16 min**
  - Sweet: 8
  - Cool: 2
  - Mint: 8
  - Bitter-pungent: 2

- **20 min**
  - Sweet: 8
  - Cool: 2
  - Mint: 8
  - Bitter-pungent: 2
Profiles of main sensory attributes in mint-flavoured chewing gum „frost”

Sample in the mouth

After sample removal

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Profiles of main sensory attributes in mint-flavoured chewing gum „spearmint”

Sample in the mouth

- **30 sec**
  - cool
  - mint
  - bitter-pungent

- **2 min**
  - cool
  - mint
  - bitter-pungent

- **3 min**
  - cool
  - mint
  - bitter-pungent

After sample removal

- **12 min**
  - cool
  - mint
  - bitter-pungent

- **16 min**
  - cool
  - mint
  - bitter-pungent

- **20 min**
  - cool
  - mint
  - bitter-pungent

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RESULTS

Time-Related-Profiling (TRP) procedure - refreshing tablets
Time –related profiles (TRP) of mint- flavoured refreshing tablets

"extra strong"

"spearmint"
Time-course intensity of main sensory attributes in mint-flavoured tablets

"fresh mint"

- Time [min]
- Intensity
- sweet
- mint
- bitter-pungent
- cool

"extra strong"

- Time [min]
- Intensity
- sweet
- mint
- bitter-pungent
- cool

"spearmint"

- Time [min]
- Intensity
- sweet
- mint
- bitter-pungent
- cool

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Profiles of main sensory attributes in mint-flavoured chewing tablets „fresh mint”

Sample in the mouth

30 sec

3 min

5 min

After sample removal

7 min

13 min

20 min
Profiles of main sensory attributes in mint-flavoured chewing tablets „extra strong”

Sample in the mouth

30 sec
- sweet 8
- cool 2
- mint
- bitter-pungent

3 min
- sweet 8
- cool 2
- mint
- bitter-pungent

5 min
- sweet 8
- cool 2
- mint
- bitter-pungent

After sample removal

7 min
- sweet 8
- cool 2
- mint
- bitter-pungent

13 min
- sweet 8
- cool 2
- mint
- bitter-pungent

20 min
- sweet 8
- cool 2
- mint
- bitter-pungent
Profiles of main sensory attributes in mint-flavoured chewing tablets „spearmint”

Sample in the mouth

30 sec

3 min

5 min

After sample removal

7 min

13 min

20 min
Time-Related-Profiling (TRP) procedure in several aspects seems to be more efficient to measure time-course of the attributes in both refreshing products because:

⇒ discrete measurement and recording on sound signal was much easier task for panelists (lower variability of results)

⇒ recording all 4 attributes at the same time resulted their equal bias

⇒ collection of the data required only 25% of time needed for CT-I procedure (realistic time-frame of measurement)
CONCLUSION

The methodology of T-I measurement of refreshing products (food and non-food ones) is strongly related to the very special sensory characteristics of the material. It requires:

- Understanding peculiarities of chemesthesia (irritating perception) in contrast to well-known chemoreception (smell and taste perception);
- Taking in account human psychological abilities and limitations to focus attention on intensity changes of one sensation over very long time (it concerns also trained and experienced members of analytical panel);
CONCLUSION

• Taking into consideration practical realization of T-I characteristics of refreshing products (realistic time-frame of the task).

The presented TRP procedure illustrates the problem and might be considered as one of possible solutions.
Thank you for your kind attention