Sensory Evaluation Of Fragrant Raw Materials

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What is Sensory Evaluation?

- Sensory evaluation is not solely tasting.

- It encompasses all five senses – vision, audition, taste, smell and touch.

- It involves the measurement and evaluation of sensory characteristics of food; and interpretation of responses.

- It provides the link between the manufacturer and consumer.
Why Sensory Evaluation?

Acceptance of a food product is determined by sensorily perceivable characteristics.

Food products are multidimensional and should be evaluated in these terms – color, appearance, odour, texture, aroma, taste and overall quality.

Instrumental analysis of individual components do not provide a satisfactory estimate of food quality and acceptability.

Instrumental methods are not available to integrate the measures of stimuli for texture, taste and aroma to provide data which reflect overall quality for acceptance.
Sensory Evaluation is a scientific discipline used to evoke, measure, analyze and interpret reactions to characteristics of food and materials as perceived by sense of sight, smell, taste, touch and hearing.
ACTIVITIES OF SENSORY SCIENCE DEPT.
Sensory Evaluation Lab

• Understanding the objective of the project
• Recruit the right panel for the test
• Minimize errors from the samples
• Lab. with individual booths
• Descriptive evaluation and training area
• Colour and Lighting
• Air circulation, Temperature and Humidity
Do not try to assess too many samples at once. Break them into small sets and test with a rest in between.

Design your test to minimize errors and bias assessors.

I. Physiological Factors
   (i) Adaptation
   (ii) Enhancement/Suppression

II. Psychological Factors
   (i) Expectation Error
   (ii) Error of habituation
   (iii) Stimulus error
   (iv) Logical error
   (v) Halo effect
   (vi) Order of presentation
   (vii) Mutual suggestion
   (viii) Lack of motivation
   (ix) Capriciousness Vs Timidity

Analyze and present the result for best effect
SENSORY PERCEPTION

Stimulus → Sensation → Perception → Responses

DEPARTMENT OF SENSORY SCIENCE

Higher brain functions

Visual
Auditory
Olfactory
Gustatory
Tactile

R & D
Industry
Storage
Processing
Consumer

Quality

Out put
Decision

In put
METHODS OF SENSORY ANALYSIS

Stimulus
Colour, Odor, Texture, Aroma, Taste, after taste

Analytical tests
Sensitivity
Psychometric Test
Threshold
Time Intensity
Dose Response Study

Discrimination
Paired Comparison
Duo-trio
Triangle

Qualitative
Ranking
Inversion

Quantitative
Ratio Scaling
Profiling
Scoring
Rating
Structured
Unstructured
Magnitude

Acceptance
Accept
Reject

Preference
Prefer
Detest

Hedonic
Like
Dislike

Laboratory Tests

Consumer Tests
PSYCHOPHYSICAL STUDIES:
It is a branch of psychology studies the relationship between the sensory stimuli and human responses

Psychometric - Response oriented
Psychophysical – Stimulus oriented

Steven’s - ‘Equal stimulus ratios” produce “equal subjective ratios”.

Exponential law is as follows

\[ R = kC^n \]

\[ \log R = n \log C + \log k \]

Where ‘n’ in the exponential equation is the slope of the logarithmic plot.

When sensory scores and stimulus concentration are plotted on a log – log basis, if ‘n’ exceeds 1.0, it is stated that the response accelerates with the concentration. If ‘n’ is less than 1.0, the sensory response decreases with the concentration.
Thresholds are the limits of sensory capacities.

Minimum level of stimulus required to give rise to a sensation.

Geometric dilution series - for setting concentration level

Arithmetic dilution series – for fine tuning

Detection – ‘?’ Recognition – ‘X’ Difference - 1,2, ...(JND)

Pungency Threshold

Scoville Heat Units (SHU) – Reciprocal of the highest dilution of the series
DEPARTMENT OF SENSORY SCIENCE, CFTRI
THRESHOLD TEST

Name: ______________ Date: ______________

Objective: Determination of taste threshold for sweetness

Procedure:
- Taste the solution in the given order
- Use the intensity scale given below
- Describe the stimulus of each sample at the threshold.

Intensity Scale
None or blank solution 0
Different from blank ? (doubtful)
Threshold value X (just perceptible)
Weak 1
Medium 2
Strong 3
Very Strong 4

<table>
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<tr>
<th>Series I</th>
<th>Series II</th>
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<tbody>
<tr>
<td>Code No.</td>
<td>Intensity Score</td>
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Threshold Value (g%)

<p>| | |</p>
<table>
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<tr>
<td>Sugar (Sweet)</td>
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<td>Sodium chloride (Salt)</td>
<td>0.25</td>
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<td>Quinine sulphate (Bitter)</td>
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<td>Citric acid (Sour)</td>
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<td>Mono Sodium Glutamate (Umami)</td>
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<td>Acesulfame – K</td>
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<tr>
<td>Aspartame</td>
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Signature
Applications:

- Threshold values are the spring boards for other data generation.
- Detection thresholds are used to determine the degree of air pollution and to set legal limit for polluters.
- Identification of the point at which known contaminants begin to affect acceptability of food and water.

- Difference threshold for determination of ingredient / process variation in a product.
DOSE RESPONSE RELATIONSHIP

Defined as the response to a stimulus for a series of concentrations or doses.

Applications:

- Gives sucrose equivalence values - sweeteners
- Helps in deciding use levels for sweet-based foods.
TEMPORAL / TIME INTENSITY STUDY

It is a technique that measures the intensity of a stimulus with reference to time.

Examples: Sweeteners / aroma,
Sweetness of a beverage
Chewing gum

Uses:

Helps in tracing the intensity of flavour/taste of samples and during storage.
DISCRIMINATION TESTS

1. PAIRED COMPARISON
   - Samples are given in pairs.
   - Equal numbers of A & B and B & A and at random order.
   - Panelists to identify if there is any difference among the pairs.

2. DUO-TRIO
   - One sample is reference.
   - Determine which of the samples in the pair matches the reference.
   - Statistical analysis by referring the table.
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<th>Number of judgements</th>
<th>Minimum concurring judgements for one-tailed test</th>
<th>Minimum concurring judgements for two-tailed test</th>
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<td>25</td>
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3. TRIANGLE

- Taste the samples on the tray from left to right.
- Two samples are identical and one is different.
- Select the odd or different sample.

Statistical Analysis – Significance is established by referring to the table.

Simple test with minimum training

Large number of panelists (more than 30)

Two samples analyzed at a time.
QUALITATIVE TEST

Ranking Test

• Estimate the differences between the samples
• Samples more than 3. Upper limit is 5
• Minimum 30 assessors
• For a number of products is to be compared for intensity of quality difference
• For screening purpose
• For initial optimization of products
• For shelf life studies.

Statistical Analysis: Kramer’s Ranksum table & Friedman’s test
Quantitative Descriptive Analysis (QDA)

“QDA method is a type of trained panel procedure in which all the sensory properties of a product are described and their intensities are quantified.”

Descriptor Generation (free choice/forced choice Profiling)

Discussion on Descriptors

Definition & Agreement on Descriptors

Scorecard – Structured/unstructured (15 cm – anchoring)

Replicate Assessment

Test Sample- one at a time

Decode and Edit

Data Analysis

SENSEORY FLAVOUR PROFILE OF PEPPER SAMPLES

- Panniyur 1
- Panniyur 5
- Commercial
- Balankotta
MERITS

• Able to evaluate multiple products
• Complete description of all the sensory properties of products
• Limited number of panelists (6 – 8)
• Quantitative information and
• Useful data
CONSUMER ACCEPTANCE TESTS

1. HEDONIC TEST
2. PREFERENCE RANKING TEST

Consumer tests are conducted for -

- Product maintenance
- Product improvement/optimization
- Development of new products
- Assessment of market potential
- Product category review

• Untrained panelists
• More number
• Minimum information

Target Population of product user
Direction and length of an attribute vector provide information of attribute importance in explaining the difference between the products.
OPTIMISATION BY RESPONSE SURFACE METHODOLOGY

- RSM provides an economical way to predict the value of one or more response over a range of independent variables
- Determines the interrelationship among the test variables
- Describes combined effect of all the variables on the responses
- Describes behavior of the test variables on the responses
- Reduces number of experiments and cost.
### Correlations between composition, texture and sensory attributes

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<th>moisture</th>
<th>fat</th>
<th>peak force</th>
<th>Colour adhesion</th>
<th>crisp oily</th>
<th>mealy</th>
<th>done ness</th>
<th>o.q</th>
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<td>-0.73*</td>
<td>1.00</td>
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<td>adhesion</td>
<td>0.70*</td>
<td>0.17</td>
<td>0.86**</td>
<td>-0.87**</td>
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<td>crispness</td>
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<td>0.89*</td>
<td>-0.29</td>
<td>-0.17</td>
<td>-0.21</td>
<td>1.00</td>
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<td>oiliness</td>
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<td>doneness</td>
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<td>-0.55</td>
<td>0.83**</td>
<td>-0.60</td>
<td>-0.33</td>
<td>-0.67*</td>
<td>-0.60</td>
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<td>o.q</td>
<td>0.22</td>
<td>0.3*</td>
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<td>-0.58</td>
<td>0.66*</td>
<td>-0.08</td>
<td>0.03</td>
<td>-0.34</td>
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* Significant at p=0.05
** Significant at p=0.01
others are non significant at p=0.05

Measures strength of linear relationship between the two variables
Flavour- Chemical Sense

Flavour is that attribute of a substance, which causes a simultaneous reaction of sensation of taste on the tongue and odour in the olfactory centre in the nose.

- Odour quality cannot be correlated with the chemical structure.
  - Hexanol - Grass-like, green, herb-like
  - Lemon – α-pinene, β-pinene, α-limonene, citral, citronellal, linalool, α-terpineol

- Carrier /Elevated temperature/pH/ matrix influences the flavour release
No single constituent is responsible for the characteristic flavour of the food. Synergy and antagonism exist between compounds.
OLFACTION

150 – 200 different odours, Anosmia

- Olfactory nerve - olfaction
- Trigeminal nerve - irritation due to chemicals and chilli - pungency, cold, burn sensation
- Terminal nerves - specific to humans

Retronasal olfaction
Orthonasal olfaction
MECHANISM OF AROMA PERCEPTION (OLFACTION)

Odour molecule
  ↓
Nasal cavity
  ↓
Olfactory Mucosa
  ↓
Olfactory Receptors on cilia
  ↓
Activation of G-protein
  ↓
Opening or closing of specific ion channels
  ↓
Triggers the nerve system
  ↓
Passing on nerve impulse to CNS*
  ↓
Recognition of specific aroma
Instrumental Flavour Analysis- GC,GC-MS,
GC-Bioassay/GC Sniff – Port Analysis / GC – Olfactometry(GCO)

It deals with sensory measurements of odours present in the GC effluents at different retention times. GCO is a collection of techniques which uses human subjects as detectors on gas chromatograph and as olfactometer, to deliver pure dose of odourants to human subjects.

Sniffing at the Exit Port of the GC by the trained panelist at different retention time corresponding to GC peaks
The % of concentration corresponding to the peaks is used to correlate the GC Olfactometry data
ELECTRONIC NOSE

The E-nose, like human nose makes a global analysis of volatiles emitted from a sample, and performs a classification process by comparing the sample with the data base.

3 major parts:
- Sample delivery system
- Detection system
- Computing system

Head space volatiles reach the sensor chambers, sensor reacts, experience change in electrical properties, recorded digital data, processed by built-in software.
Comparison of biological smelling and e-nose

Pattern Classification by Built-in Software using PCA, CDA and ANN techniques
METAL OXIDE SENSORS

- Metal oxides are semi-conducting materials (e.g., ZnO) which are gas sensitive.

- Sensors comprise of a thin layer of an oxide film deposited on a ceramic tube or plate and heated to temp. 175° to 450°C.

- Selectivity depends on catalytic amounts of a doping metal (Palladium for tin oxide sensors) introduced as a trace impurity on the sensor surface.
Sensor output

Change in Resistance (ohms)

Time (s)
DISCRIMINATION OF ODOR BY E-NOSE
- CORIANDER

R1-R5
Spicy
Herbal

R6
Earthy
Spicy

R7 & R8
Pleasant
Cooling
Floral
Green

C1: 89.55%

C2: 10.45%
ELECTRONIC TONGUE
Model: α ASTREE LIQUID AND TASTE ANALYZER, Alpha MOS, France

E-tongue or taste analyzers have the capacity to perform global analysis of the chemical compounds responsible for taste in liquids to deliver a global taste profiling, in a way similar to human perception of taste.

Operational features

• Sensors with different partial selectivities
• The detection is based on a change in the electrical resistance
• Reference electrode and sensors are dipped in a beaker containing test solution for 2 min., a potentiometric difference between each sensors and reference electrode is measured, recorded by E-tongue software.
E Tongue pattern matching for Sugar solution

Sugar
(2%, 4%, 8%, 16%, 32%, 64%)
Taints are odours or flavours that are essentially foreign to the food products, but have been inadequately introduced by contact or exposure. Any taint may lead to consumer complaints, or loss of repeat purchase, and some taints may also represent health risks.

Types of Off-flavour by packaging material - Plastics, lubricants, styrene, vinyl chloride
Paper coated laminates – gluey, waxy, burnt, oily, polyethylene, metallic
Ink and Varnish – solventy, painty, inky
Sensory evaluation by descriptive test

Results are analysed, presented either by pictorial representation or tables
E-Nose Pattern Matching of Butter Samples

C1 : 97.09%

C2 : 2.87%

T1
T2
M1
M2
BL
Taint Detection by Sensory Jar Test

Dry

27°C, 65% RH  38°C, 90% RH
24 h  48 h  24 h  48 h

Wet

27°C, 65% RH  38°C, 90% RH
24 h  48 h  24 h  48 h

Sensory Profile of Packaging material

Plasticky
Musty
Cardboardy
Fatty
Solventy
Painty
Gluey

Chemical

Best Poster Paper Award for Taint Detection Method – ICFOST 2002
Potential sources of Taint

- Contact with painted surfaces or the solvent from paint used on floors, walls, ceilings or equipment, not necessarily only in the immediate vicinity of the food.
- Flooring in the food preparation or storage areas. There may be a particular problem with curing agents used when new floors are laid or old floors repaired.
- Disinfectants used directly on the processing line or to clean equipment, containers, lorries, floors, etc. In general, disinfectants should always be stored away from the preparation area and should never contain chlorophenols.
- Packaging materials used for the ingredients or the final product. In addition to the actual packaging material, printing inks may give rise to taints, as may the action of container sealing, especially heat sealing of plastic containers.
- Local atmosphere: some cases are known where taints have transferred from local atmosphere to the food, for example, the odour from pesticide spraying. Other foods may cause transfer of taints; for example, onions stored in the same room as cakes are likely to impart a taint of the cakes.
Consultancy Projects – Taint detection

Taint Test:
- Floor topping material – Nitoflore – SL 2000
- Floor topping material – Cipoxy coating material
- Floor topping material – Niticole EP 405
- Glucose packed in Zip pouches
- Teflon coated vessels

Jar Test:
- Polystyrene sheet
- Packaging materials
- Cardboard materials used for packing foods
- 100% pure instant coffee powder packed in cans
- Empty cans, crown cork liners, pearlpet containers
THANK YOU