TRAINING SCHOOL
SENSORY ANALYSIS OF WATER

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TASTE AND ODOR IN EARLY DIAGNOSIS OF SOURCE AND DRINKING WATER PROBLEMS: WaterTOP COST ACTION (CA18225)

Background

Water sector has traditionally focused its efforts on providing a product with health guarantees. However, the consumer does not evaluate the water by taking into account the regulations but rather in terms of its aesthetic properties. Companies are aware of this and are making a noteworthy effort to improve the odour and taste of water.

Membrane technology has become an extraordinarily useful tool. They improve the flavour of waters on reducing the concentration of organic compounds, but they notably reduce the TDS and change the distribution of the ions. These changes modify the taste of the water and influence the perception of the consumer.

Remineralization of desalinated water has to be dessigned tanking into account taste considerations in addition to health and corrosion control reasons.

Background

•Understanding the basics of tap water taste. G.Burlingame, A.Dietrich, A.Whelton.

J.A.W.W.A 99:5 (2007)100-110

“The need to understand the role of minerals in the taste and nutritional value of drinking water is timely for the drinking water industry”

Ions that cause taste

Parameter	TTC (mg/L C^+ or A^-)	Perception	USEPA (SMCL)	EU 98/83 Directive	WHO Guidelines
Na^+	30-460 * 51 (NO_3^-), 59-82 (Cl^-), 65-81 (SO_4^{2-}) 115-290 (HCO_3^-)	Salty		≤200	≤200
K^+	162 (Cl^-)	Salty/bitter			
Ca^{2+}	100-300*				≤80 **
Mg^{2+}	100-500 *	Bitter/astringent			
Cl^-	200-300 * 91-127 (Na^+)	Salty, C^+ modulated	≤250	≤250	≤250
SO_4^{2-}	169 (Na^+)-705 (Ca^{2+})	Salty, gypsum, chalk	≤250	≤250	≤250
HCO_3^-	305-770 (Na^+)				
TDS	NA	Objectionable taste when high	≤500	≤1600 ***	≤1000

*: depending on co-ion
**: corresponding to a hardness of 200 mg/L CaCO3
***: corresponding to a conductivity of 2500 uS (20 ºC)

Source:
*Understanding the basics of tap water taste. G.Burlingame, A.Dietrich, A.Whelton. JAWWA 99:5 (2007)100-110
*Advances in taste-and-odour treatment and control. I.H.Suffet, J.Malleviale, E.Kawzynski. Chapter 6, by L.Matía. AWWA RF – Lyonnaise des Eaux. 1995. Denver, CO (USA)
*Water Quality in Distribution Systems. K.S Smith and R.Slabaugh, eds.Chapter 5, by. J.Sutherland, R. Devesa, A. Dietrich and F. Ventura. First Edition. AWWA. Denver, Co (USA). 2017.

Ions that cause taste

An extremelly complex issue ¡

The taste of drinking water depends not only on TDS but on the distribution of the present salts

Cations and anions interact between them, and sinergistic and antagonistic effects are present

The complexity of this issue produces discrepancies into:

- (p+) or (n-) effects of some species
- Results from sensory analyses depend of:

*Temperature
*Age

* Type of tasters
* Sensory method

Odor also counts

Flavour = Taste + Odour

* Chlorine, the most common descriptor for tap water

* Pharmaceutical

Odor/flavour events

*natural

*geosmine and MIB (Wuxi, 2007)

*chlorophenols, …

*antropogenic/chemical spills

*dioxanes

*solvents

*4-(methylcyclohexyl)-metanol (4-MCHM)

Sensory analysis

* **Descriptive techniques**

Perception of sensory attributes which define the product: descriptors and sensory profile

* **Thresholds determination (OTC, TTC)**

What is the minimum detectable (or recognition) concentration?

* **Afectives tecniques: hedonic, acceptance, preference)**

Do you like it? Is it acceptable for you? Which one do yo prefer?

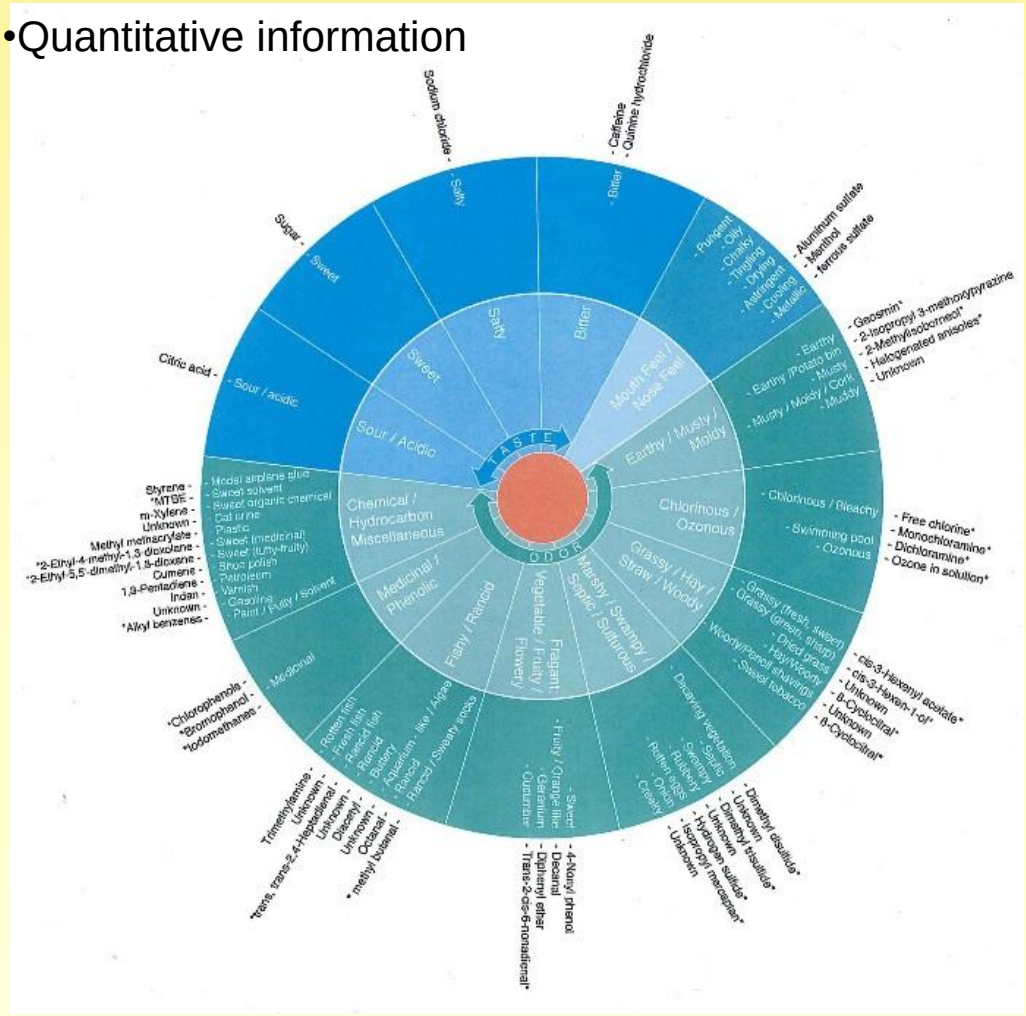
* **Difference tests**

Is it possible to discriminate among samples?

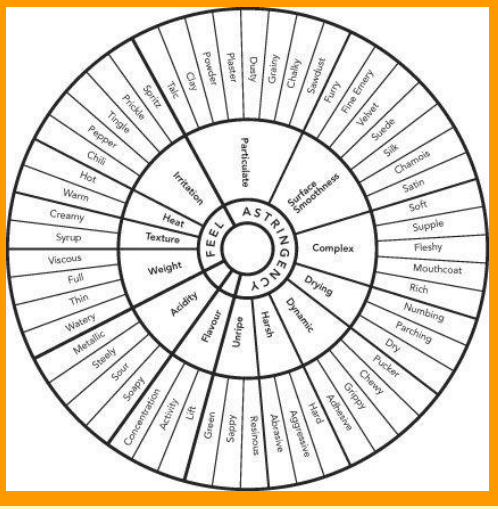
Descriptive techniques

Flavour Profile Analysis (SM 2170)

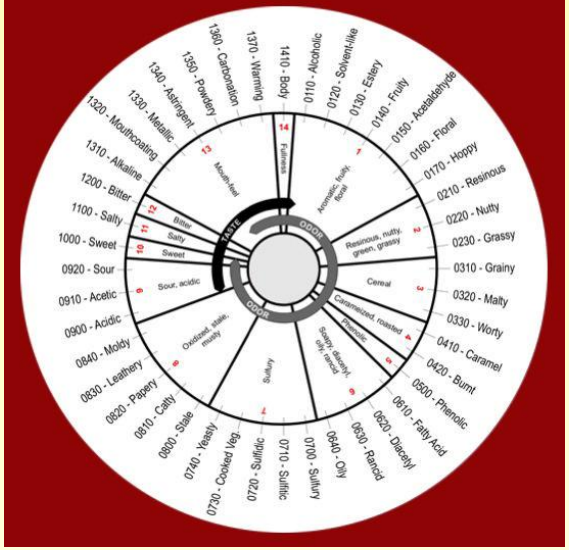
- Descriptors /Attributes /Terminology
- Quantitative information



DAVIS UNIV. WINE WHEEL

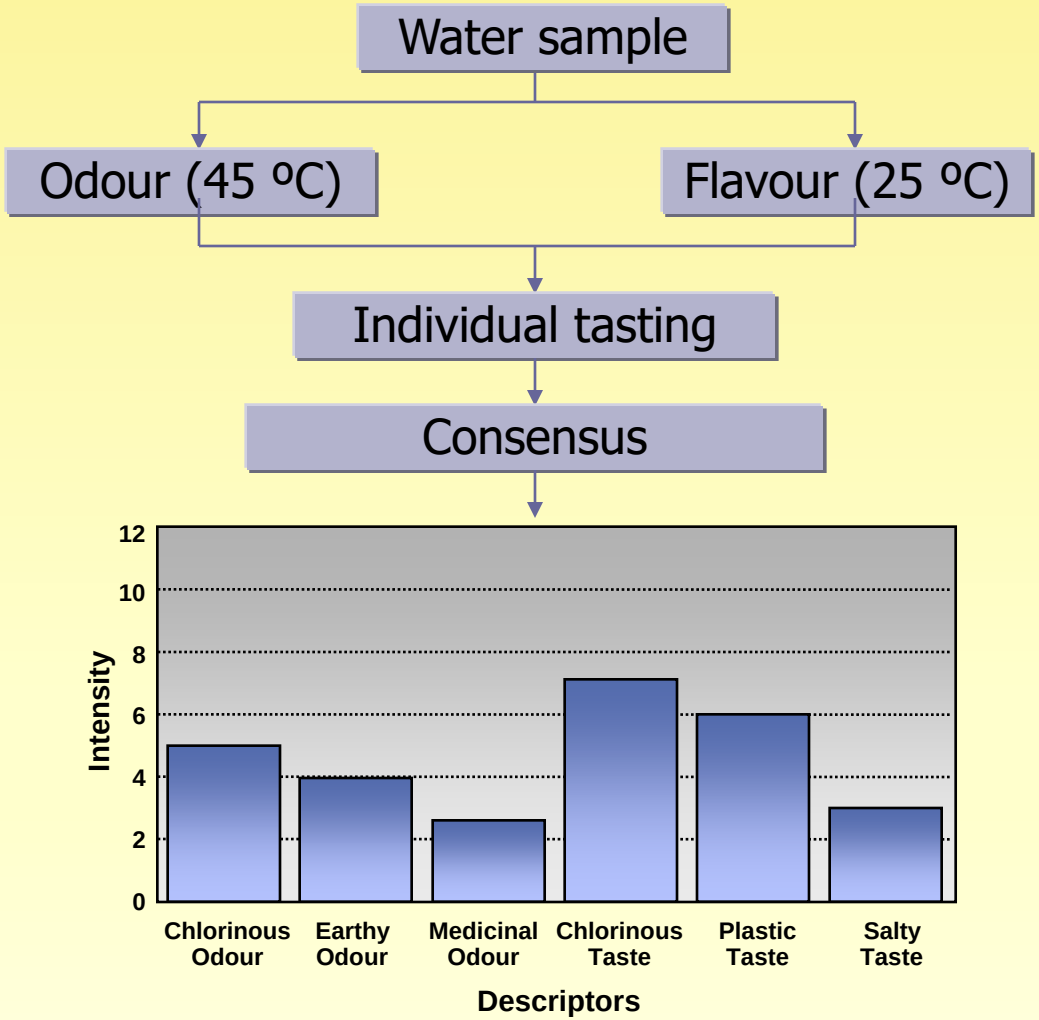


THE MEILGAARD BEER FLAVOR WHEEL
BY DR. MORTON MEILGAARD



Descriptive techniques

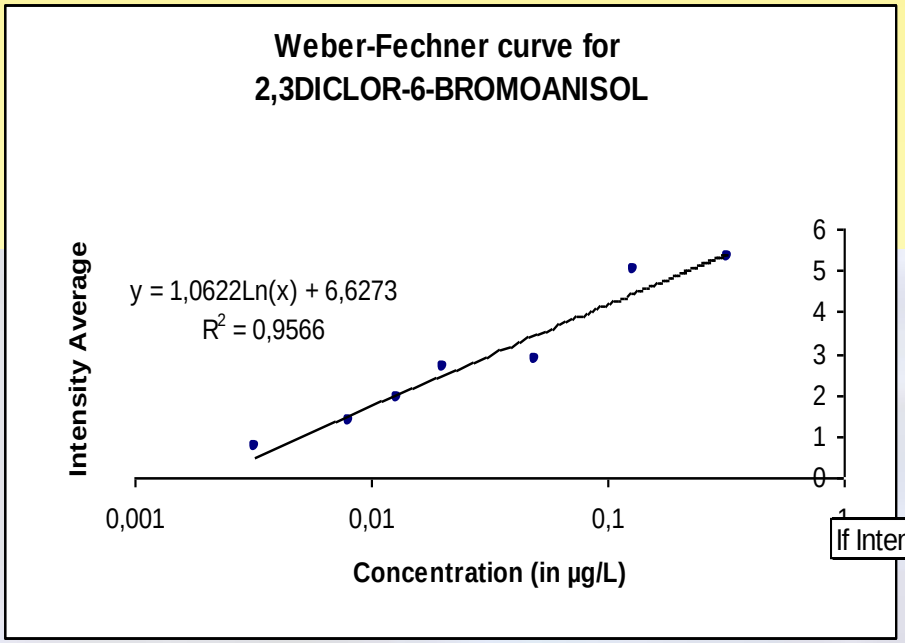
Flavour Profile Analysis (SM 2170)



Thresholds determination

(In fact, thresholds estimation)

Weber-Fechner curve/ Quantitative FPA



If Intensity = 1 in Weber-Fechner curve, then OTC = 0,005 µg/L

Descriptors**:** rubbery, apple, grassy, leather, cardboard

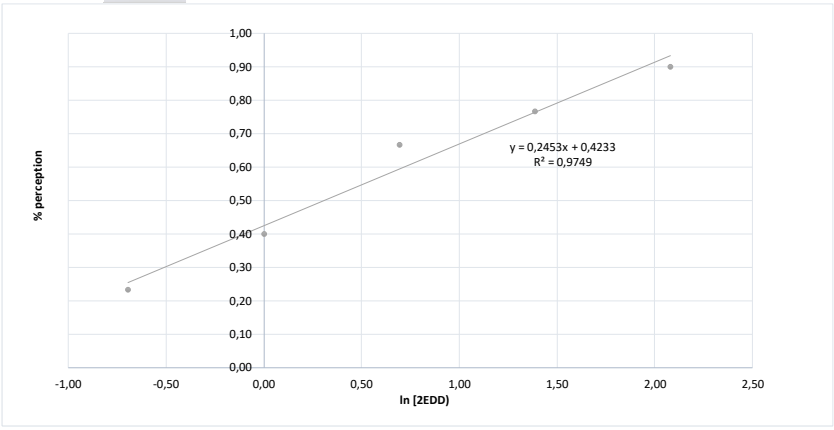
Thresholds determination

3-AFC (Three Alternative Forced Choice),

Odor Threhold Concentration (OTC)
Compound: 2EDD
Temperature: 45 °C
Panel: volunteers
Factor: 2.0

Step	1	2	3	4	5	6	7	8	Geometric mean	
[2 EDD] (ng/L)	0,13	0,25	0,50	1,00	2,00	4,00	8,00	16,00		
ln C	-2,08	-1,39	-0,69	0,00	0,69	1,39	2,08	2,77		Correct answers
Panelist 1									0,18	7
Panelist 2									0,71	5
Panelist 3									0,35	6
Panelist 4									0,35	6
Panelist 5									0,35	6
Panelist 6									0,71	5
Panelist 7									1,41	4
Panelist 8									1,41	4
Panelist 9									1,41	4
Panelist 10									1,41	4
Panelist 11									1,41	4
Panelist 12									0,35	6
Panelist 13									2,83	3
Panelist 14									2,83	3
Panelist 15									2,83	3
Panelist 16									11,31	1
Panelist 17									2,83	2
Panelist 18									1,41	4
Panelist 19									1,41	4
Panelist 20									0,71	5
Panelist 21									5,66	2
Panelist 22									0,71	5
Panelist 23									5,66	2
Panelist 24									0,35	6
Panelist 25									0,71	5
Panelist 26									1,41	4
Panelist 27									11,31	1
Panelist 28									5,66	2
Panelist 29									22,63	0
Panelist 30									0,35	6

Global geometric mean:	1,41



50 % perception:	1.37 ng/L
25 % perception:	0.49 ng/L

Affective techniques

Hedonic, Acceptance and Preference tests

* Ranking
* Scoring (rating, scaling)
* Classification
* Acceptance
* Preference

Difference tests

Discriminating among samples

*Overall or specific attribute

* Magnitude of the difference

* Difference + Preference

* **Triangular test** (AAB, ABA, BAA, BBA, BAB, ABB)
  Balanzed
  Ranmdomized
  Forced

* **Test 2-out-5** (AAABB, AABAB, ABAAB, …n=20)

* **Duo-trio** (A: AB, A:BA)

But the legislations …

Threshold Odour Number (TON) / Threshold Taste Number (TTN)

Simple

Quick

Dilution method: do not correspond to product consumer receives

DWD 98/83 EU

Acceptable to consumers and no abnormal change
No method is specificed

Thanks for your attention