Objective

For gelatins used as functional ingredients in the food industry, flavor and taste quality are of utmost importance since it can impact the sensory features of final products.
Functional ingredients are usually assessed by trained human sensory panels.
This study proposes to investigate the use of instrumental sensory analysis to assess commercial gelatin samples and to compare the results to an expert panel evaluation.

Electronic Sensing Instruments

Tests on odor, taste and vision attributes were conducted respectively with FOX electronic nose, ASTREE electronic tongue and IRIS electronic eye (Alpha MOS, France).

The FOX instrument analyzes the headspace of the samples. It includes eighteen Metal Oxide Sensors that react to volatile compounds (change of electrical resistance) and measure the global odor fingerprint of products. It is further equipped with a HS100 autosampler (CTC Analytics, Switzerland) to automate sample incubation and injection.

FOX Electronic Nose

The ASTREE electronic tongue analyzes organic and inorganic compounds dissolved in liquids that are responsible for taste. The detection principle is based on a potentiometric measurement with seven ChemFET (Chemical modified Field Effect Transistor) sensors.

ASTREE Electronic Tongue

Samples & Analytical Method

Twenty samples from 3 types of gelatins (10 bovine, 6 porcine, 4 fish powders diluted in water) were assessed by a sensory panel (Table 1) and analyzed with the FOX and the ASTREE Electronic Tongue (Table 2).

Sensory Panel Evaluation

- 7 attributes: bitter, salty, sweet, milky, grilled, nut, pungent
- Scoring scale from 0 (weak) to 5 (strong)

Table 1: Sensory scores determined by the panel on 7 attributes

Sample	Description	Bitter	Salty	Pungent	Milky	Grilled	Nut	Sweet
BEE1	Bovine collagen peptide	4.1	5.0	2.3	0.5	4.9	2.0	3.9
BEE2		2.7	2.4	1.1	2.2	3.2	2.4	1.9
BEE3		1.6	0.9	1.0	3.3	1.5	1.7	1.1
BEE4		3.3	2.3	1.5	3.1	3.3	2.7	1.7
BEE5		2.9	2.1	1.1	2.1	2.0	1.9	1.1
BEE6		0.6	0.0	0.2	3.6	0.6	3.0	0.6
BEE7		2.0	0.6	1.0	2.5	1.5	2.0	0.5
BEE8		1.8	0.8	0.8	3.7	1.2	2.5	0.5
BEE9		1.5	0.6	0.8	4.1	1.3	2.6	0.9
BEE_U			Unknown					
FIS1	Fish collagen peptide	5.0	5.0	4.7	0.8	3.6	3.0	4.1
FIS2		4.1	2.4	2.4	1.4	1.4	2.2	2.0
FIS3		0.6	0.6	0.2	4.2	0.8	5.0	0.2
FIS_U			Unknown					
POR1	Porcine collagen peptide	1.4	2.5	1.6	3.2	2.4	1.2	1.5
POR2		1.8	1.6	1.1	3.0	1.7	1.8	0.9
POR3		1.8	1.0	0.4	3.3	1.8	1.8	1.1
POR4		1.4	0.5	0.4	3.1	0.9	5.0	0.4
POR5		0.8	0.2	0.0	3.5	0.2	4.7	0.0
POR_U			Unknown					

Table 2: Instruments Analytical Conditions

FOX electronic nose parameters	
Sample mass	1 g in a 10mL vial
Incubation temperature	80°C
Incubation time	30 min
Injected volume	2.5mL
Syringe temperature	90°C
Acquisition time	120 s
ASTREE electronic tongue parameters	
Sample volume	25 mL
Acquisition time	120 s

Sensory Attributes Scoring

For each type of gelatin (bovine, porcine, fish) and each sensory attribute, a correlation coefficient between each E-Nose & E-Tongue sensor measurement and each sensory panel assessment was calculated.

For each type of gelatin and each attribute, a score quantification model was set- up by selecting the sensors showing the highest correlation on this attribute.

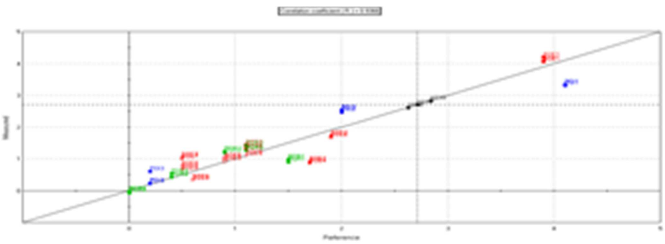

Fig. 1: Partial Least Square model for sweet attribute scoring of fish gelatin

For example, the quantification model of sweet attribute in fish gelatin (fig.1) was set up based on all E-Nose and E-Tongue sensors measurement. The correlation coefficient between instruments and human evaluations was high (93.7%).

Determination of sensory scores of unknown samples using E-Nose model

Sample	Description	Bitter	Salty	Pungent	Milky	Grilled	Nut	Sweet
BEE_U	Bovine	3.1	3.3	0.0	1.4	1.2	2.7	0.0
FIS_U	Fish	3.8	3.5	2.6	1.7	4.0	4.6	2.7
POR_U	Porcine	3.2	2.4	1.3	2.7	2.7	1.2	1.6

Comparison of gelatins sensory profile

A first plotting of E-Nose (fig. 2) and E-Tongue measurements on Principal Component Analysis models, allowed to show the differentiation of the various types of gelatins (porcine, bovine, fish) based on odor and taste profiles. To compare more precisely sensory panel evaluation to instrumental analysis, specific models were set-up by type of gelatin.

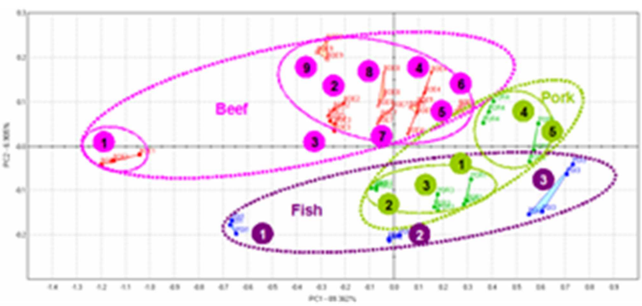

Fig.2: Principal Component Analysis of gelatin odor profiles (E-Nose measurement)

Bovine gelatin analysis, for which more sample were available, will be presented as an example.

The analysis of sensory panel data highlighted 2 groups of samples (fig. 3):

- ✓ one group with low scores on grilled, bitter, pungent, salty and sweet attributes and high scores on milky and nut notes (samples BEE2 to BEE9)
- ✓ sample BEE1 having high scores on grilled, bitter, pungent, salty and sweet attributes and weak milky and nut notes.

The combination of E-Nose & E-Tongue data, showed the same grouping of bovine gelatins (fig. 4).

Unknown bovine gelatin was projected on this qualitative model (in blue on fig. 4) and was found to have sensory features close to the ones of BEE2 and BEE7.

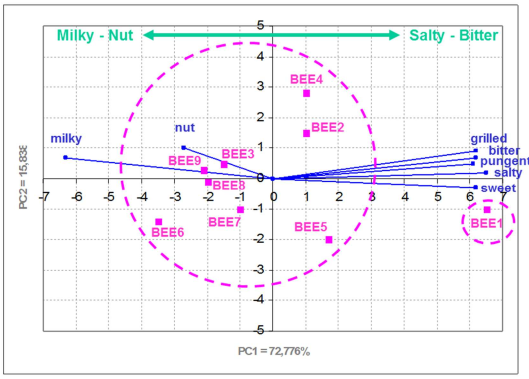

Fig.3: Principal Component Analysis of bovine gelatins (Sensory panel)

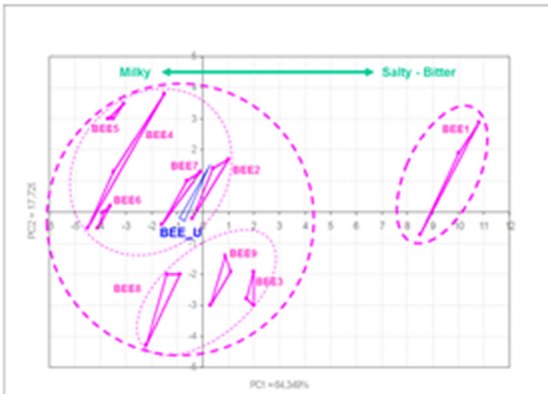

Fig. 4: Principal Component Analysis of bovine gelatins (E-Nose & E-Tongue measurement)

Conclusion

This study showed the possibility to use electronic nose & tongue to map a sensory profile of gelatins for quality control. More generally, these analyzers can avoid time-consuming panel sessions for routine analysis of functional ingredients.