Objective

Today, food industries face new market challenges: varied and rapidly changing consumers preferences, increasing demand for healthy and safety-oriented products, ever greater consumption of cooked and processed food
In the development of consumer food products targeting desirable flavor attributes, electronic nose & tongue instruments are viewed as helpful analytical tools and a powerful complement to human sensory evaluation in quality control or product development applications.
This presentation describes the sensory evaluation of various formulations of snacks, with an aim to select the optimized product that will meet the market expectations.

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

Eight formulations of snacks were analysed both by a sensory panel and by E-nose & E-Tongue. The sample set includes snacks obtained based on different manufacturing processes that lead to different textures. The samples were pulverized using blade mixer before analysis, to get homogenised samples.

Sample set

Samples	Details
E, F, H	Manufacturing process A
A, B, C, D, G	Manufacturing process B

Sensory Panel Evaluation

The panel of trained assessors used a Quantitative Descriptive Analysis based on 26 descriptors among which 7 for texture, 5 for aroma, 14 for flavor

Instruments Analytical Conditions

E-Nose

Quantity of sample:	2 g in 20 mL vial
Headspace generation:	15 min at 80°C
Injected volume:	2.5 mL
Syringe temperature:	90°C
Acquisition time:	120 s

E-Tongue

Quantity of sample in beaker:	25 mL*

*extraction of the solid samples in water, and filtration before analysis

Temperature of samples:	ambient
Acquisition time:	120s

Comparison of human & instrumental profiling

- ✓ **Texture**: the 2 groups corresponding to 2 manufacturing processes are clearly distinguished (fig. 2).
- ✓ **Flavour and Taste**: E product is perceived as caramelized, H & F as cooked flavor and sugar; D, G & C are the oiliest and A the saltiest.

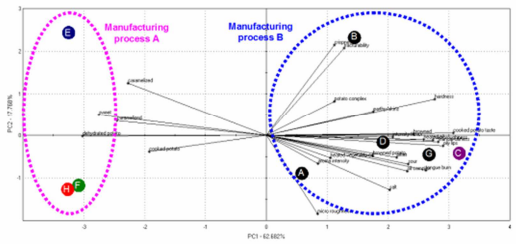


Fig. 2: PCA of expert panel scoring on Snack Products

The combination of E-Nose & E-Tongue measurements showed the same grouping of samples as the sensory panel (fig. 3).

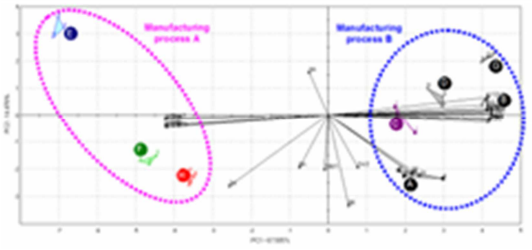
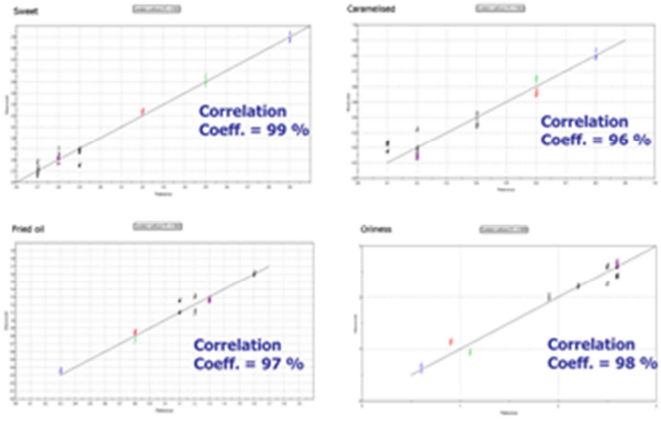


Fig. 3: PCA of e-nose and e-tongue measurements on Snack Products

Sensory Attributes Scoring

Partial Least Square (PLS) models were set-up to evaluate the level of correlation between instruments' measurements and sensory panel scoring on each sensory attribute.



Excellent correlation was obtained by analyzers measurement with sensory descriptors. In Figure 4, are shown various examples of PLS obtained on "sweet", "caramelized", and "fried oil "," oiliness attributes.

E-nose and E-Tongue proved to correlate with other attributes than smell and taste (oiliness).

Conclusion

This application showed that E-Nose & E-Tongue analyzers allows to:

- reduce the workload of sensory panel,
- evaluate process impact on flavor,
- decrease the formulation costs by giving valuable products to sensory panel
- increase the lab productivity by speeding up decisions.