**Meat odor discrimination using a mass spectrometry-based electronic nose.**

G. Grigioni*, N. Pensel* and W. J. Harper**

* Food Technology Institute, National Institute for Agricultural Technology, CC 77, 1708 Morón, Buenos Aires, Argentina.
** Department of Food Science and Technology, The Ohio State University, 2121 Fyffe Road, Columbus, Ohio 43210.

**Keywords**
Meat odor, species, mass-spectrometry based electronic nose

**Background**

Meat flavor studies emphasize the analysis and identification of key compounds related to specific meat flavor and aroma notes. Several volatile compounds were identified in different types of meat, contributed with relevant information for simulate meat flavoring used in processed food.

Species-specific flavor notes are mainly related to differences in lipid-derived volatile compounds. Several work were done comparing pork, chicken, beef and lamb volatile composition and associated mechanisms. For unsaturated aldehydes, one of the major contributors to cooked meat flavor, the variations among these species could be associated with the higher proportion of unsaturated fatty acids in triglycerides in pork and chicken compared to beef and lamb (Mottram, 1998). Ramarathnam et.al. (1991) analyzed the influence of certain carbonyl compounds in cured and uncured cooked meat flavor, and related odor species characteristics to a group of volatile compounds, observed in different concentrations depending on the meat, that included hexanal, 2-hexenal, 16octadexenal among others.

Food odor characteristics has been analyzed commonly by human assessment and headspace/direct gas chromatography/mass spectrometry. However, growing interest exist in the use of electronic nose concept for volatile profile analysis. In the case of mass spectrometry-based electronic nose (MS-based E-nose), the volatile compounds are introduced, with or without previous chromatographic separation, in a mass spectrometer. Then, each mass to charge ratio in the obtained mass spectrometric pattern is treated like a sensor response curve in standard electronic nose (Shiers, 1999).

**Objectives**

In this work is considered the applicability of MS-based E-nose in meat flavor analysis, specifically its ability to discriminate among species of cooked meat.

**Methods**

Meat samples were cooked in a convection oven at 177°C, until they reached a monitored internal temperature of 70°C. For each type of meat, two samples were prepared for being analyzed in different runs of the E-nose.

Sample preparation was performed using the procedure defined in a previous work where it was used the same E-nose with different meat and meat products (Harper, 2000). Briefly, meat samples were carefully fat trimmed, cut in slices and homogenized in a Waring Blendor for 60s at high speed. Then, 5g of the sample were placed in 22ml vials and sealed. For each type of meat, 4 vials were analyzed per run.

The E-nose used was a Hewlett-Packard HP4440A Chemical Sensor that comprises an automatic headspace sampler coupled to a quadrupole mass spectrometer. During analysis, oven temperature was held at 60°C, loop temperature at 80°C and transfer line temperature at 90°C. Vial equilibration time was set at 30min and mix options was enable. The E-nose was used in SIM-Mode, without previous chromatographic separation of volatile compounds, scanning from 50 to 200 m/z. Bellow 50 no inspect was done in order to exclude fragments for air. Electron impact with electron energy of 70eV was the ionization mode selected.

**Results and discussion**

Mass spectra of the samples were analyzed on Pirouette software. In Figure 1 is presented a Cluster Analysis plot that shows a clear separation of beef, lamb and pork samples respect to chicken. In this analysis, all of the mass to charge ratio were included. The same results were obtained for the two runs of the E-nose.

Using PCA (Principal Component Analysis) Predict model was possible to establish a particular set of fragment ions that shows different mass abundance between the two cluster: 55, 58, 61, 63, 66, 68, 71, 73, 76, 78, 80, 83, 185 and 188 m/z ratios, as is shown in Figure 2. In this model chicken samples were considered as the reference group and the other type of samples were compared against. This particular group of fragment ions could be considered as the optimum "sensor array" for the application described in this work (Nitz, 1999).

Using the Mass spectral Library of the device those m/z ratios are associated to the compounds listed in Table 1. For component individualization, it is necessary to change the operation system mode to enable a chromatographic separation of the headspace components prior to reach the mass analyzer. However based on previous results described in the literature, those are the compound to be expected in this matrix.

**Conclusion**

The MS-based electronic nose used in this work has been shown to be suitable for spices associated meat odor analysis. Special care must be taken in sample preparation in order to minimize mass abundance variance between replicates to improve discrimination between samples.

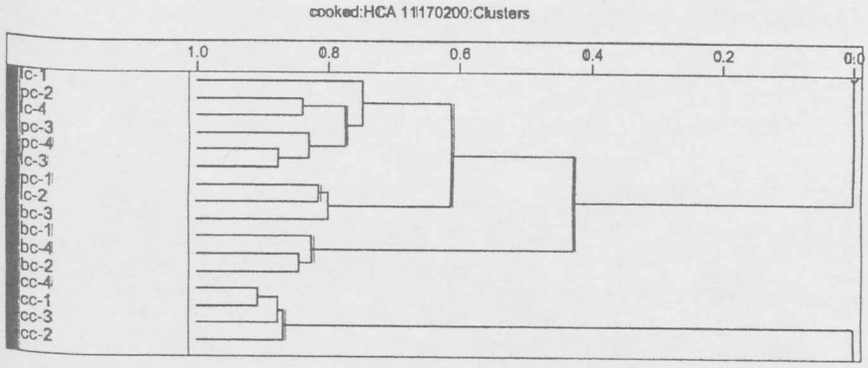


Figure 1. Cluster analysis. LC means cooked lamb, PC means cooked pork, BC means cooked beef and CC means cooked chicken.

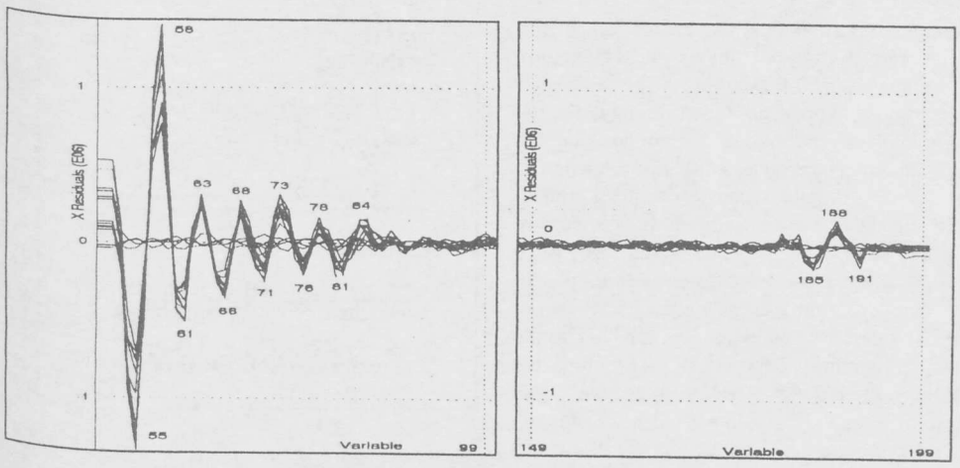


Figure 2. PCA Predict model results. Pork, beef and lamb samples compare against chicken samples that were considered as references (Y-axe correspond to m/z ratio).

| Table 1 - Mass units - Electron impact ionization mode | | | |
|---|---|---|---|
| **Compound** | **Mass Unit** | **Compound** | **Mass Unit** |
| 55 | Aromatic aldehyde, aromatic ketone, aliphatic thiols | 75 | Ethyl esters |
| 56 | Hexanal, aliphatic thiols | 77 | Aromatic acids |
| 57 | Aliphatic aldehyde, ketone, ethyl esters | 83 | Pyridines |
| 58 | Aldehyde, ketone | 84 | Aromatic thiols |
| 59 | Esters | 85 | Ketones, pyrones |
| 60 | Aliphatic acid, methyl esters, thiosters | 87 | Esters |
| 61 | Thioketals | 89 | Thiols |
| 66 | Pyroles, disulfides | 92 | Lactones |
| 68 | Pyridines | 98 | Aromatic thiols, ketones |
| 69 | Cyclic ketone, aliphatic thiols | 103 | Ethyl esters |
| 70 | Aliphatic thiols | 108 | Aromaticthiols |
| 71 | Methyl esters, ketones, furans, thiazoles, benzylthiophenes | 120 | Aromatic thiols |
| 72 | Aldehydes, ketones | 124 | Aromatic sulfides |
| 74 | Methyl esters | 138 | Lactones |

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