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FAST PROCESSED MEAT QUALITY ANALYSIS THROUGH AN "ELECTRONIC NOSE"

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Background:

New technologies, such as electronic aroma sensing are powerful tools that could be used to define and predict product quality beyond traditional quality parameters. This technology has been used successfully in different applications in the food and beverage industries, such as classification of agricultural product off-odors (Persaud et al., 1996), seafood, grains (Maul et al., 1997), cheese (Harper et al., 1997), etc. This technique is a new alternative to chemical and sensory analysis that food scientists traditionally used to study food flavor and aroma.

An electronic nose is a sensor-based instrument designed to respond to the volatile compounds present in the headspace over the sample. This equipment consists of an array of non-specific broad-selectivity sensors able to detect aroma compounds with great sensitivity, in terms of a change in the sensor electrical impedance on exposure to a range of odors. The relative response of each individual sensor produces a pattern; these patterns together can be used as a "fingerprint" characteristic of the sample considered. The sensor array combined with an artificial neural network is able to emulate the cognitive processes used by the brain during sensory impulses (Maul 1997, 1998).

Objective:

As part of a major study to develop new processes for cooked meat, a study was carried out to assess the ability of an electronic nose to identify and classify meat aromatic profiles analyzed at different times after cooking, compared both with chemical and sensory test results.

Methods:

Thirty Semitendinosus muscles were vacuum-packaged in cook-in bags (Cryovac) and cooked into a computer-controlled *Microflow* (Barriquand Steriflow, France) at 50ºC for 390min. *Microflow* execute heating and cooling cycles using a water shower. A four shelf basket allows to lock the packages into the chamber, with the possibility of operate the device with the basket in static or rotary mode. In this work, the basket in static mode was used and one muscle was locked per shelf. After cooling, shrink was eliminated and the muscles were vacuum packaged and stored at 1.5 ± 0.5ºC for 0, 2, 4, 6, 13, 20, 27, 34, 42 and 45 days. Prior to analysis the samples were reheated in a microwave oven for 9min (80% power; 1000 Watt) and immediately sampled for electronic nose, TBARS and sensory analysis. The samples for warmed-over flavor (WOF) analysis with the electronic nose were cooked in the same way, but stored at 4ºC for 3 days in a polystyrene trah wrapped with polyethylene.

For the objective aroma evaluation, an Aromascan A32/50S (Aromascan, England) was used. The acquisition period of the Aromascan analysis lasted about 5min and a time-interval of 20s in the plateau (equilibrium) stage of the curve was chosen to collect data. The aroma detection was made in one cycle (reference: 30s; sample: 180s; wash: 60s, reference: 120s), with a detection threshold of 0.2. Each meat sample (10g) was sliced and stripped (1.5x0.8x0.4cm approximately), placed into a 50ml screw-cap stoppered tube, thermostatized at 50ºC in a water bath, and analyzed using the dynamic stripping technique with nitrogen (oxygen-free quality) as carrier gas. Three replicate analyses were performed for each sample in order to generate a population cluster to the multivariate analysis and to provide repeated measures for neural network training. The number of thiobarbituric acid reactive substances (TBARS) reaction was carried out as suggested by Pensel (1990). Sensory analysis was carried out by an 8-member taste panel, analyzing flavor and aroma with 9 point scale (1= extremely bland; 9=extremely strong) and off-flavors by descriptive analysis on unstructured scales of 100mm. WOF descriptors was generated and learned during training sessions. Samples were presented in covered opaque glasses in individual booth illuminated with green light, to avoid possible differences between samples.

Results and discussion:

The results show that it is possible to find differences among samples by means of an electronic nose using dynamic stripping technique. Figure 1 shows the aroma map of the samples analyzed by Principal Component Analysis (PCA). In this figure it is possible to observe that the results for storage times t=0 to t=20 days clustered together, and samples of t=34 to t=45 days of storage grouped in a different cluster. This indicates a remarkable difference between these two groups, even though the neural network was also able to find differences among samples, even in the early stages of storage. The recognition confidence of the global classes (days of storage) for each sample was more than 89%, except for t=34 and t=40 where the recognition confidence decreased to 70%.

When samples prepared as representative of warmed-over flavor were analyzed by the electronic nose, they could be classified in the same cluster that samples of t=34 to t=45 days of storage. The recognition confidence for this samples aroma as WOF was at least 62%.

All these results are in agreement with TBARS analysis as it is shown in Figure 2. TBARS values remain low (mean value 0.1604±0.0860) up to day 20 (no significant differences were found among sampling times from day=0 to day=20 -P<0.05-). After that (day=34 to day=48), a significant (P<0.05) increase was found (mean value 0.5250±0.1900), and differences among sampling times in this second group were not significant (P<0.05).

The results also agree with taste panel results, presented in Figure 3. In this case, panelists scored the samples around 5 up to day 20 and after that, they detected off-odors that were reflected in lower values that continued decreasing along storage. Panelists identified the off-flavors found in the samples as warmed-over flavor (Figure 4).

Conclusions:

The electronic nose can successfully discriminate meat samples aroma along storage times. Results obtained were consistent with those of chemical and sensory analysis. This new technology is at least as sensitive as chemical or sensory tests, and it is also able to correctly classify samples with a specific flavor (WOF).

This technique, suitable for meat aroma analysis, offers a fast alternative method to the traditional meat chemical and sensory analysis.

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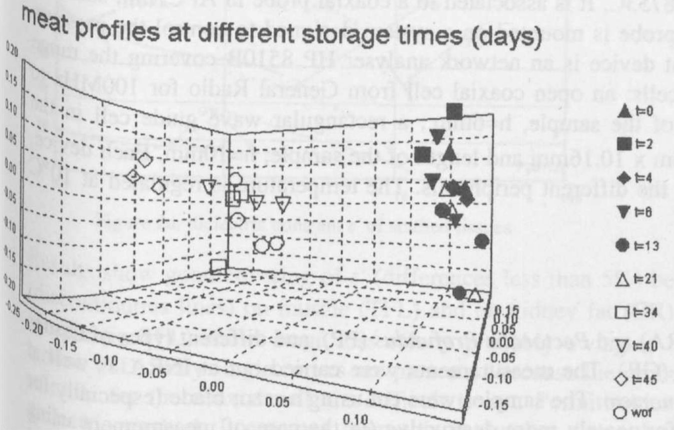

Figure 1

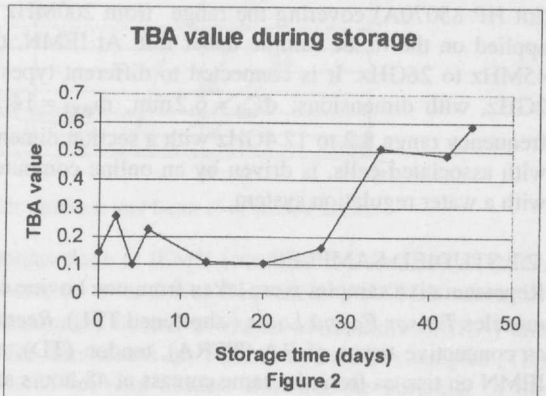

Figure 2

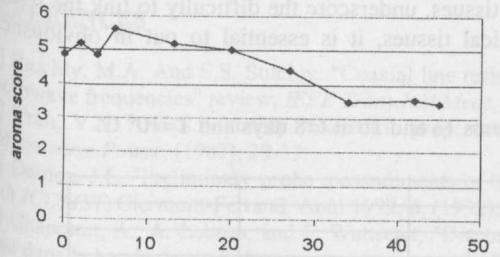

Figure 3

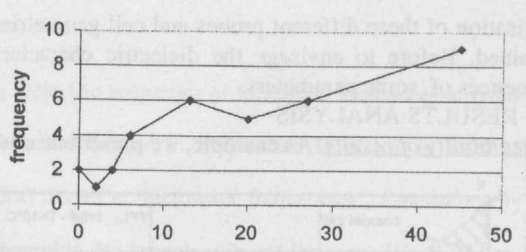

Figure 4