RELATIONSHIP BETWEEN INTERNAL TEMPERATURE AND PARAMETERS MEASURED BY AN ELECTRONIC NOSE DURING MEAT COOKING

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Introduction

Food contains several volatile compounds that are responsible for, among other properties, odour (Maul, 1998). The literature relating to the volatile compounds found in meat suggests that over 1000 chemicals have been identified (Mottram, 1998). Raw meat has only a blood-like taste but during cooking, mainly due to the Maillard reaction and thermal degradation of lipids, a wide range of volatile compounds is developed. Aroma and flavour evaluation are of great importance in food quality assessment. These analyses are usually carried out by trained panels and/or gas chromatography/mass spectrometry (GC/MS). However, the human sensory panel has a number of inherent disadvantages including subjectivity, repeatability, set-up time and costs. Also, instrumental techniques like GC/MS require much time and have a high operating cost. So researchers are constantly investigating alternative analytical solutions. One response to this problem is the electronic nose. From Persaud and Dodd (1982) this new technology is used in the agricultural sector to evaluate odours of products and food like meat, grains, coffee, beer, cheese, sugar, mushrooms etc (Schaller *et al.*, 1998). This experiment was to evaluate the relationship between the increasing internal temperature during meat cooking and the parameters measured by an electronic nose with the aim of defining the odour profile of meats.

Materials and Methods

Eight beef and 8 pork *Longissimus dorsi* muscle portions refrigerated at 4°C were used as meat sources. From each steak, a 1 cm thick circular sample (Steak) was obtained according to the MCS method proposed by Barbera (2006). A 1 cm thick circular hamburger sample (Minced) weighing 30 g was produced using the minced meat of the same steak. The internal sample temperature was measured before cooking (0 min) which was performed at 165°C for 15 min in an electric forced-air convection oven. By forcing air into the oven, after passing through an active charcoal filter, regular cooking odour out-flow was guaranteed. PEN 2 (AIRSENSE Analytics GmbH, Hagenower, Germany) is a portable electronic nose (EN) with 10 metal oxide sensors (MOS) that change their resistance in the presence of oxidising and reducing gaseous compounds (Kohl, 1992). The ten PEN2 sensors analyse 10 classes of chemicals: 2 sensors for aromatic (w1c and w3c), broad range (w5s), hydrogen (w6s), aromatic-aliphatic (w5c), broad-methane (w1s), sulphur-organic (w1w), broad-alcohol (w2s), sulphur-chloride (w2w) and methane-aliphatic (w3s). This instrument was utilised in the continuous monitoring of meat volatile compounds produced during 15 minutes cooking. The temperature probe was put into the sample at the start of cooking and the internal temperature was recorded every 30 s. In all, 32 steak and minced samples were used. Relationships between internal temperatures and sensor parameters were detected and analysed. Statistical analysis was performed by SAS (2001).

Results and Discussion

Several average internal temperatures are presented in Table 1. The internal temperature shows an obvious increasing trend during cooking but after the 11th minute, the sample preparation (steak or minced) causes a significant difference. The inclusion of air into minced meat can account for the observed delay in temperature increase. The Pearson correlation coefficients between internal temperature during cooking and the ten sensor parameters show a strong relationship (P<0.0001) for both steak and minced treatments.

Table 1: Means ± SD at different cooking times.

Time (min)	Temperature °C		
	Minced	Steak	Pr
0	17.2±1.34	17.7±1.83	NS
5	43.0±3.44	40.8±3.48	NS
10	68.6±3.01	69.9±4.51	NS
15	84.1±4.66	91.3±4.05	<0.0001

As shown in Figure 1, using the standardised data, the correlation is not always linear but polynomial. In general, sensors show an initial, linear phase: an increase in temperature causes a corresponding signal increase. The following phase shows a lack of correlation as the sensor parameter does not rise with the temperature (steak). Finally the sensor response starts rising again with the increase in temperature. It is possible to note the different trend between minced and steak preparations.

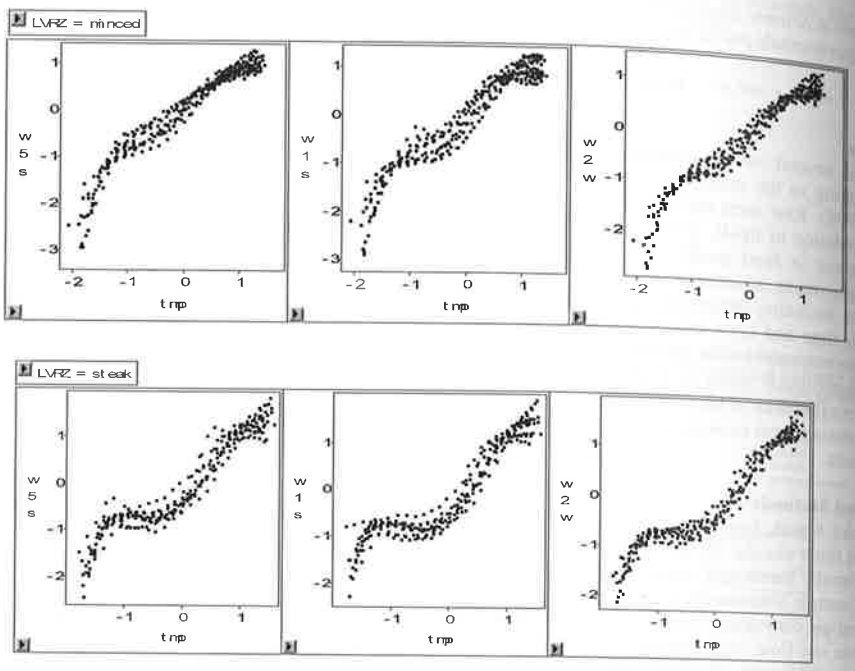

Figure 1: The relationships in minced and steak samples (lvrz) between the internal temperature (tmp) during cooking and the standardised output of three sensors (w5s, w1s, w2w) measured by an electronic nose.

Conclusions

The electronic nose appears to be useful for the investigation of global aroma characteristics in cooking meat. It emerges from this experiment that the chemicals produced during cooking are dependent in different ways on the internal temperature and the sampling mode. A minced preparation is considered to be a more representative sampling in comparison to steak. It releases volatiles in more homogeneous patterns and is less dependant on human error. Further experiments, to better define the correlation patterns, are necessary.

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