Effect of vitamin E-supplemented feed regimen on beef odour assessed by a conducted polymer sensors based electronic nose

Grigioni, G.M.; Descalzo, A.; Insani, M.; Pensel, N.A. and Margaría, C.A.

Instituto Tecnología de Alimentos - Centro Agroindustrias - INTA, Castelar. C.C. 77 - 1708 Morón, Buenos Aires, Argentina

Background.

Flavour is one of the main sensory attributes considered by consumers to judge meat quality, therefore it directly affects purchasing consumer decision. Both pre-slaughter and post-mortem factors affect cooked meat flavour characteristic (Ramarathnam *et al.* 1991). Gray *et al.* (1996) outline a classification of undesirable meat flavours, that are mainly related to oxidative rancidity, processing-induced and feed-derived flavour development, among others. Regarding to feed-derived flavours, some are related with preference and consumer choice behaviour, as it should be the case of pasture and grain. Then, when a particular population is the target of the product its preference should be taken into account.

It has been well documented that dietary Vitamin E supplementation enhance the quality of meat during storage, basically due to the increment of α-tocopherol concentration in the cell membranes, resulting in a significantly lower susceptibility to lipid oxidation. As a consequence, vitamin E may be effective to retard flavours induced by lipid oxidation.

Traditionally, human assessment and gas chromatography/mass spectrometry has been used to evaluate beef meat flavour resulting from different feeding regimens (Bailey *et al.*, 1988; Larick *et al.*, 1987; Melton, 1990). In this study it is proposed the use of an Electronic Nose (E-nose) for feed-related odour analysis. E-nose device is a sensor-based instrument designed to respond to the volatile compounds present in the headspace above a sample. The relative signals of the sensors generate a pattern that can be considered as an odour descriptor. (Persaud *et al.*, 1996).

Objective.

This study was undertaken to determine the differences in raw meat odour from animals with different feeding regimens by an electronic nose with conducting polymer sensors.

Methods.

Muscle source: *Psoas major* from steers divided into four different diets: pasture, pasture plus vitamin E supplementation (500 UIVit.E/animal/day), grain and grain plus vitamin E supplementation (500 UIVit.E/animal/day) (Descalzo *et al.*, 2000).

Muscles were vacuum-packaged immediately after cutting and deboning (24h after slaughter) and kept at 2±0.5°C until sampling 16h later. A slice of each muscle was trimmed of visible fat, cut into small pieces and a 10g-aliquot was separated for E-nose analysis. These aliquots were vacuum stored in sealed bags (Cryovac, Sealed Air S.A., Argentina) at -70°C and prior to analysis were thawed at room temperature.

An electronic nose AromaScan™ A32 (Osmetech PLC, England) with 32 conducting polymer sensors was used. The acquisition cycle of this device comprise five steps to transport the headspace from the sample across the sensor array. Based on previous results of meat odour analysis (Grigioni *et al.*, 1999) the dynamic stripping was selected as the optimums sampling technique. This method allows a constant replenish of the headspace of the sample by drawing off the air close to its surface

During E-nose analysis, the sample was kept at 50°C in a water bath with large thermal inertia. The sample container was a 50ml glass tube with stoppered screw caps. PTFE lines connected the test tube inlet to the reference air (nitrogen, oxygen-free quality) supplied by de AromaScan system and the test tube outlet to the analyser sampling port. Aroma detection was made in one cycle: reference: 30s, sample: 90s, wash: 60s, reference: 120s and 2% n-butanol-water solution as cleansing agent. The duration of each phase in the acquisition cycle was found to be sufficient to obtain a stable base line, to collect volatile compounds and to allow recovery-up of the sensors between successive analysis (Grigioni et al., 2000). An average odour pattern for each sample was calculated among three consecutive runs and was considered as representative of the sample.

Aroma data was collected in a time interval, between 180s and 210s, in the plateau part of the sensor response curve and was handle by the statistical software included in the system. In the aroma maps, data points from like samples appear together in one domain and separated from other domains that represent samples that are found to be different. The Quality factors (QFs) give an estimation of the discrimination between each pair of clusters and could be obtained from data as Euclidean distances or Malanobis number (Grigioni *et al.*, 2000). QFs values above or equal to 2 indicate a good differentiation among groups.

Results and Discussions.

In this study muscle α-tocopherol content, measured as described by Descalzo *et al.*(2000), was the variable used to test the sensors' performance. Figure 1 shows the α-tocopherol content-response curves for some sensors, when samples from animals fed with a supplemented grain-based diet were analysed. These sensors presented an almost linear dependence of their intensity signal for all the samples analysed, the intensity was measured as the change in resistance relative to the base resistance (ΔR/R). This criterion was followed to select a group of sensors (numbers 5, 6, 15, 16, 21, 23, 24, 25, 29 and 32) of the array in order to generate odour pattern profiles with normalised data that are independent of the α-tocopherol content (Persaud *et al.*, 1996).

It is also possible to see on Figure 1 that the aroma intensity decreased as the α-tocopherol content increase. This may suggest a reduced formation of volatile oxidation products due to antioxidant activity of α-tocopherol. Though, this should be confirmed with the development of oxidation that would allow the discrimination between basal diet and oxidation in related volatiles.

In Figure 2, a two-dimensional aroma-map shows the results when comparing beef odour profiles using the selected group of sensors. In this map, the separation among samples corresponding to pasture- and grain-based diet is significant. No differences were observed within in each feeding regime between samples that correspond to animals with or without supplementation. The obtained QFs values are listed in Table 1.

Other measurements were performed on the samples related to some flavour precursors such as α-tocopherol, carotenoids, fatty acids, etc (Melton, 1990). These results shown higher levels ($p<0.05$) of α-tocopherol, β-carotene and polyunsaturated fatty acids with more than two double bonds corresponding to beef produced on pasture (Descalzo *et al.*, 2000). Consequently, E-nose results are in accordance with the differences observed between diets in those flavour precursors.

Conclusions.

The results described shown that E-nose technique used can discriminate odour profiles of raw beef, at the beginning of refrigerated storage, coming from grain- and pasture-fed steers.

No clear differentiation is attained within each feeding regime (supplemented and no supplemented diets). It can be expect that for samples with more days of storage, the differentiation would be achieved as oxidation process develops.

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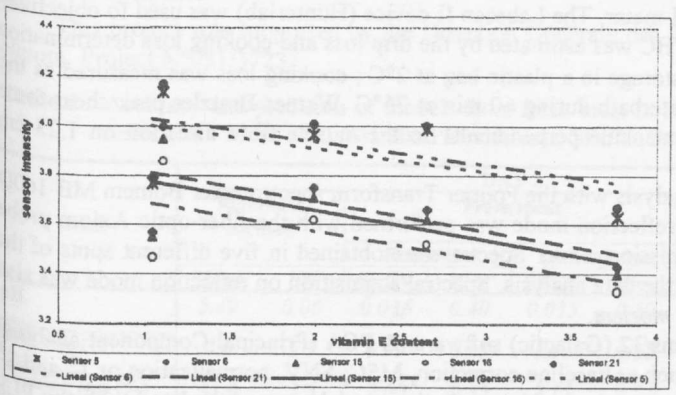

Figure 1- Intensity response (ΔR/R) of some sensors as a function of muscle α-tocopherol content (μg / g tissue)

Quality factors (QFs)			
	Pasture	**Pasture suppl. Vit. E**	**Grain suppl. Vit. E**
Grain	22.105	29.457	0.309
Grain suppl. Vit. E	23.344	31.111	
Pasture suppl. Vit. E	0.218		

Table 1- Quality factors between difference feed regimens calculated for the aroma map shown in Figure 2.

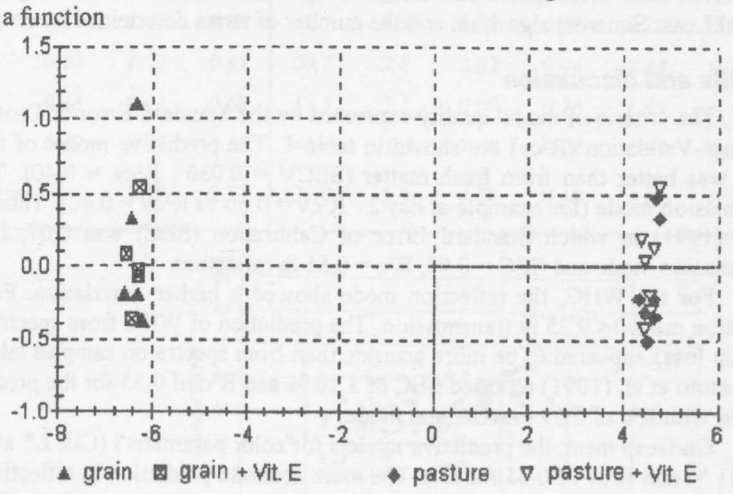

Figure 2 - Beef odour profiles, analysed with Sammon Statistical procedure assessed by an electronic nose.