EFFECT OF NITRITE AND NITRATE ON THE GENERATION OF AROMA ACTIVE COMPOUNDS IN DRY FERMENTED SAUSAGES

A Marco, JL Navarro and M Flores*
*Instituto de Agroquímica y Tecnología de Alimentos (CSIC), P. Box 73, 46100 Burjassot (Valencia), Spain. *E-mail:* mflores@iata.csic.es

Keywords: Aroma, dry fermented sausage, cured, nitrite and nitrate.

Introduction

The use of nitrate and/or nitrite in the manufacture of dry-fermented sausages depends on the geographical origin. In the Mediterranean countries both nitrate and nitrite are used indistinctly. In 1991, Wirth described a better taste in dry sausages made with nitrate or low amounts of nitrite than in those with usual amount of nitrite. However, few works have studied the effect in flavour development of each agent individually (Stahnke, 1995, Olesen et al., 2004). Generally, the flavour generation in dry fermented sausages have been studied including a pre-incubation stage, that is, a rapid fermentation process, in their manufacture. On the other hand, only a few studies have compared the effect of either nitrite or nitrate in a slow process without fermentation (Navarro et al., 2001, Marco et al., 2006). The aim was to study the individual effect of these curing salts on a slow fermentation process, focusing on those volatile compounds with a high aromatic impact to determine its effect on the typical dry-cured flavour.

Materials & Methods

Dry fermented sausages. Two different batches containing nitrate (NO_3^-) or nitrite (NO_2^-) were manufactured as described by Marco *et al.* (2007) and three sausages were collected at 111 days.
Volatile compounds GC-MS analyses. Volatile compounds were extracted, analyzed and quantified as described by Marco *et al*. (2007).
Volatile compounds GC-O analyses. Volatile compounds were extracted using SPME (solid phase micro-extraction) using the same procedure cited for GC-MS analyses. The compounds adsorbed by the fibre were desorbed in a gas chromatograph (GC 8000 Top, CE Instruments, Milan, Italy) injection port for 6 min at 240 ºC in split-less mode. The compounds were separated using a DB-624 capillary column (J&W Scientific, 60 m, 0.32 mm i.d., film thickness 1.8 mm). Helium was used as the carrier gas with a linear velocity of 35.14 cm/s. The capillary column was split (2:1) into deactivated and uncoated capillaries connected with the sniffing port and FID, respectively. The detection frequency method was used to estimate the aromatic impact of each volatile compound (Linssen et al., 1993) in the different batches. Six trained assessors evaluated the odours from the GC-effluent by smelling and recording the retention time and odour descriptors of every perceived odour. The evaluation of the odour took place over two different time intervals (0-35 and 35-70 min) in order to avoid olfactory fatigue of the assessors. The detection of an odour in the sniffing port by less than three assessors was considered to be noise. The final detection frequency value (DF) for each compound was obtained by summation of the 18 sniffings for each batch.

Results & Discussion

The analysed dry fermented sausages showed 55 different aroma-active zones (figure 1). Most of the aromatic zones were chemically identified except ten compounds. Of the identified odour-active compounds: 15 were aldehydes, eight alcohols, seven organic acids, six ketones, six esters and two furans. All these compounds had already been detected in the headspace of dry fermented sausages (Marco et al., 2006). The use of the detection frequency method did not show any difference in the odour active compound profile between nitrite or nitrate-added batches, but only differences in the ratio of some of them. 13 compounds presented higher DF values in nitrite-added sausages. Amongst them, five presented differences higher than five DF units: ethanol, 1-hexanol, propanoic acid, 2-heptenal and nonanal. Other eight, showed differences of 3 or 4 DF units: acetone, methanethiol, ethyl pentanoate, 1-pentanol, 2,4-heptadienal (E,E) and 1-octanol. On the other hand, in the nitrate-added sausages, phenylacetaldehyde and 3-methylbutanal were 4 and 3 DF units higher, respectively.
Compounds such as hexanal, 3-methyl-butanoic acid and acetic acid have generally been reported as potent odorants in fermented sausages (Schimdt and Berger, 1998, Blank et al., 2001) and probably, they are essential contributors to the overall dry cured aroma; although the contribution of other esters, aldehydes and acid compounds should be considered.

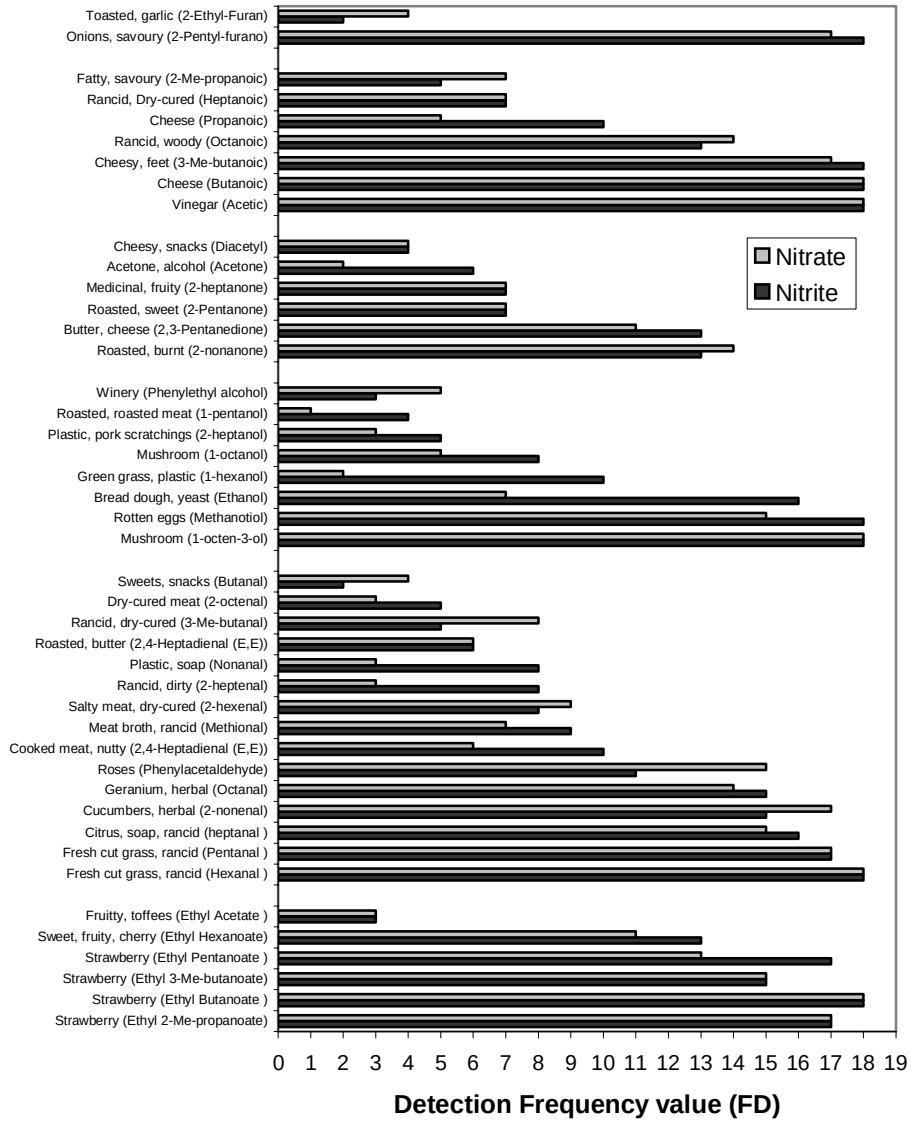

Figure 1. Odour active zones described in dry-fermented sausages processed using nitrate or nitrite. The identified compound in parenthesis was obtained by GC-MS and confirmed using authentic standards.

Conclusions

In conclusion, this study has shown that there are not a specific odour-active compound related to the use of nitrite or nitrate although there are differences in the detection frequency value of several compounds. The nitrite added sausages presented higher DF values for ethanol, 1-hexanol, propanoic acid, 2-heptenal and nonanal while the nitrate added sausages had higher DF values for phenylacetaldehyde and 3-methyl-butanal.

Acknowledgements

The scholarship from CSIC/MEC to A. Marco and financial support from grants AGL2005-00713 (MEC, Madrid, Spain) and GV05/067 (Generalitat Valenciana, Spain) are fully acknowledged.

References

Blank, I., Devaud, S., Fay, L. B., Cerny, C., Steiner, M. & Zurbriggen, B. (2001). In: G. R. Takeoka, M. Güntert, and K. H. Engel (Eds.) pp. 9-20. Washington, D.C.: American Chemical Society.

Linssen, J. P. H.; Janssens, J. L. G. M.; Roozen, J. P.; Posthumus, M. A. *Food Chemistry*. 1993, *46*, 367-371.

Marco, A., Navarro, J. L. & Flores, M. (2006). *Meat Science*. 73: 660-673.

Marco, A., Navarro, J. L. & Flores, M. (2007). *European Food Research and Technology*, http://dx.doi.org/10.1007/s00217-006-0556-x

Navarro JL, Nadal MI, Nieto P, Flores J (2001) *European Food Research and Technology* 212: 421-425

Olesen PT, Meyer AS, Stahnke L H (2004) *Meat Science* 66:675-687

Schmidt, S.; Berger, R. G. *LWT-Food Sci. Technol.* 1998, *31*, 559-567.

Stahnke LH (1995) *Meat Science* 41:179-191

Wirth F (1991) *Fleischwirtschaft* 71:1051-1054