Chemical and Microbiological Changes in British Fresh Sausage

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SUMMARY: Microbial growth in unsulphited fresh British-style pork sausages reached high levels on day five of manufacture. This was associated with changes in colour and odour confirmed by instrumental determinations. Levels of reducing sugars increased along with microbial growth followed by steady depletion.

INTRODUCTION: The fresh British-style pork sausage is a traditional, inexpensive, nourishing product that is still popular today. However, from the scientific point of view, sausages are complicated emulsions that are a very easy target for microorganisms. Sulphur dioxide (SO_2) is an effective preservative (450 mg kg^{-1} maximum) since it elects the types of organism that grow, allowing Gram positive bacteria and yeasts to dominate (Banks et al., 1982). However, there is a growing demand for preservative-free foods. If SO_2 is removed from the sausages, a different microbial population is found and spoilage occurs more rapidly although it is associated with organoleptic changes (odour and colour) linked to microbial metabolism rather than the number of organisms present.

Brochothrix thermosphacta is the dominant microflora in sulphited and unsulphited sausages (Sulzbacher et al., 1951; Gardner, 1981). It is known that Brochothrix in culture media produces different end-products depending on the carbon source (Dainty et al., 1980, 1983). The possibilities of improving shelf life of unsulphited sausage by influencing microbial metabolism towards less odorous end-products by introducing different carbon sources to the sausage formulation is under investigation. The growth of microorganisms, the utilisation of sugars, changes in colour and the appearance of key volatiles have been followed.

MATERIALS and METHODS: **Manufacture of sausages.** Sausage was manufactured by bowl chopping: pork shoulder, 49%; back fat, 32%; iced water, 11%; rusk, 6.15%; seasoning (Bloomfin), 1.85%; for 100 revolutions. The mass was filled into Devro casings (21 mm) and stored at 5°C.

Microbiological analysis. Sausage samples (10 g) were stomached in peptone water and dilutions (10^{-2} - 10^{-8}) plated on a) STAA (Oxoid) for the enumeration of Brochothrix thermosphacta at 22°C; b) Pseudomonads CFC agar base (Oxoid) for the enumeration of pseudomonads at 22°C, and c) Nutrient agar (Gibco) for total viable counts at 30°C. Duplicates were incubated for two days.

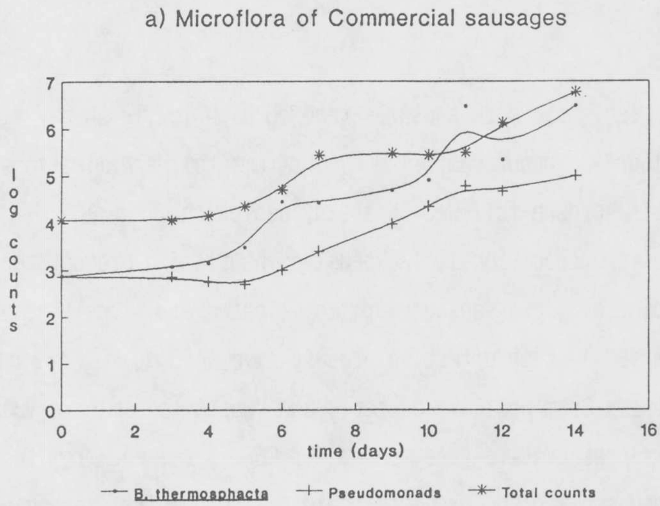
Reducing sugars. The technique was based on that of Poe (1932) using a UNICAM SP500 Spectrophotometer (λ=510); results were expressed as glucose equivalent from a calibration curve.

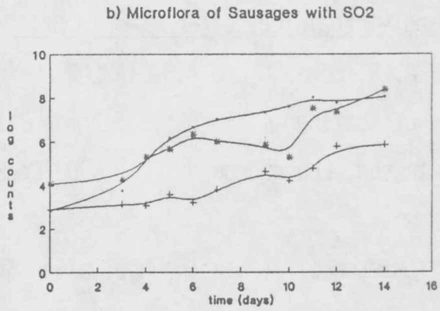
Volatile analysis. Volatiles were collected from sausage samples (Taylor et al., 1990) and analysed on a BP20 column (SGE; 25 m, 0.22 mm i.d.) mounted in a Hewlett-Packard 5890A GC. Chromatography from 40-230°C at 5°C min^{-1} using helium carrier gas (1 ml min^{-1}) separated the components which were analysed in a HP5970 MSD at 70 eV.

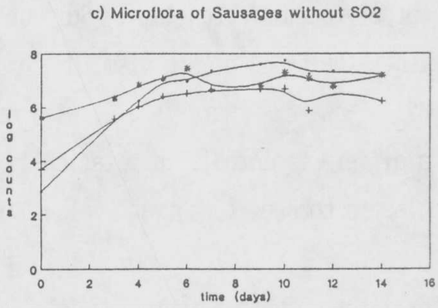
Colour. The L*, a* and b* values were obtained (five replicates) using a Hunter Lab ColorQUEST.

RESULTS and DISCUSSION: The microbiological analysis results are summarised in Figure 1. The growth curves for Brochothrix, pseudomonads and TVC are similar in the commercial sample (Fig 1a) and our lab-prepared sample (Fig 1b). In the sample with no preservative, the rate of growth was greater reaching 10^{+7} cfu g^{-1} in 5 days whereas in the sulphited sausages, the same level was achieved after 10 days. Brochothrix was evident at

FIGURE 1: Levels of Microorganisms in sausages







earlier stages in unsulphited samples even though it has been reported that sulphite has no effect on its gr (Welsby et al., 1977; Gardner, 1981). The numbers of pseudomonads is small but important because of their ability to metabolise one of the off-odours (acetoin) (Molin et al., 1986) produced by Brochothrix (Dainty e 1980; Stanley et al., 1981; Edwards et al., 1987). Reducing sugars levels in sausages (Fig 2) showed chan during storage. Although spoilage organisms use these compounds, all samples showed an increase in reducing sugars followed by a decrease. The reason for this is unclear but it may be due to polysaccharide breakdown caused by enzymes or chemical means. Colour measurements during storage are shown in Figure 3. Visually, t samples darkened. The plot of L* versus storage time shows no correlation to this observed change although plots a* and b* against time do show a good correlation. Six key volatiles compounds were analysed to see w they appeared in the storage trials (Fig 4) and whether they could be correlated with the microbial growth curves. Some trends are apparent but there is no close correlation with the growth curves. Diacetyl tended come out very quickly.

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FIGURE 2: Profile of Reducing Sugars in sausages

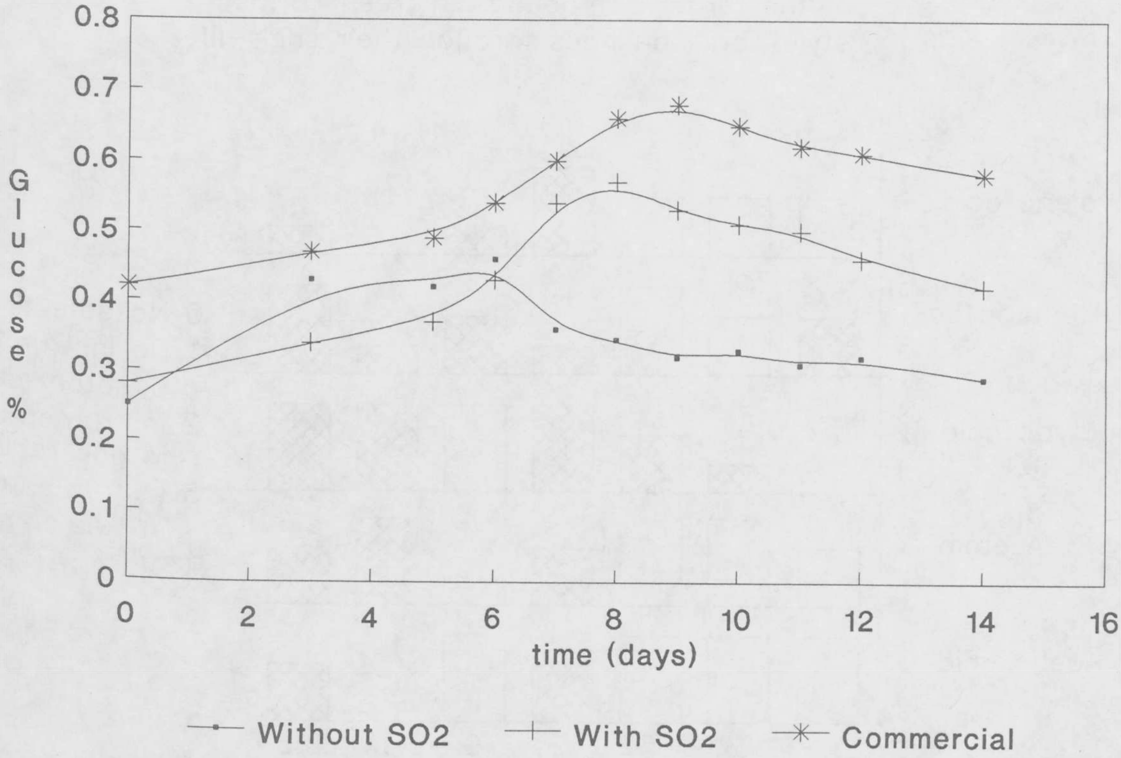
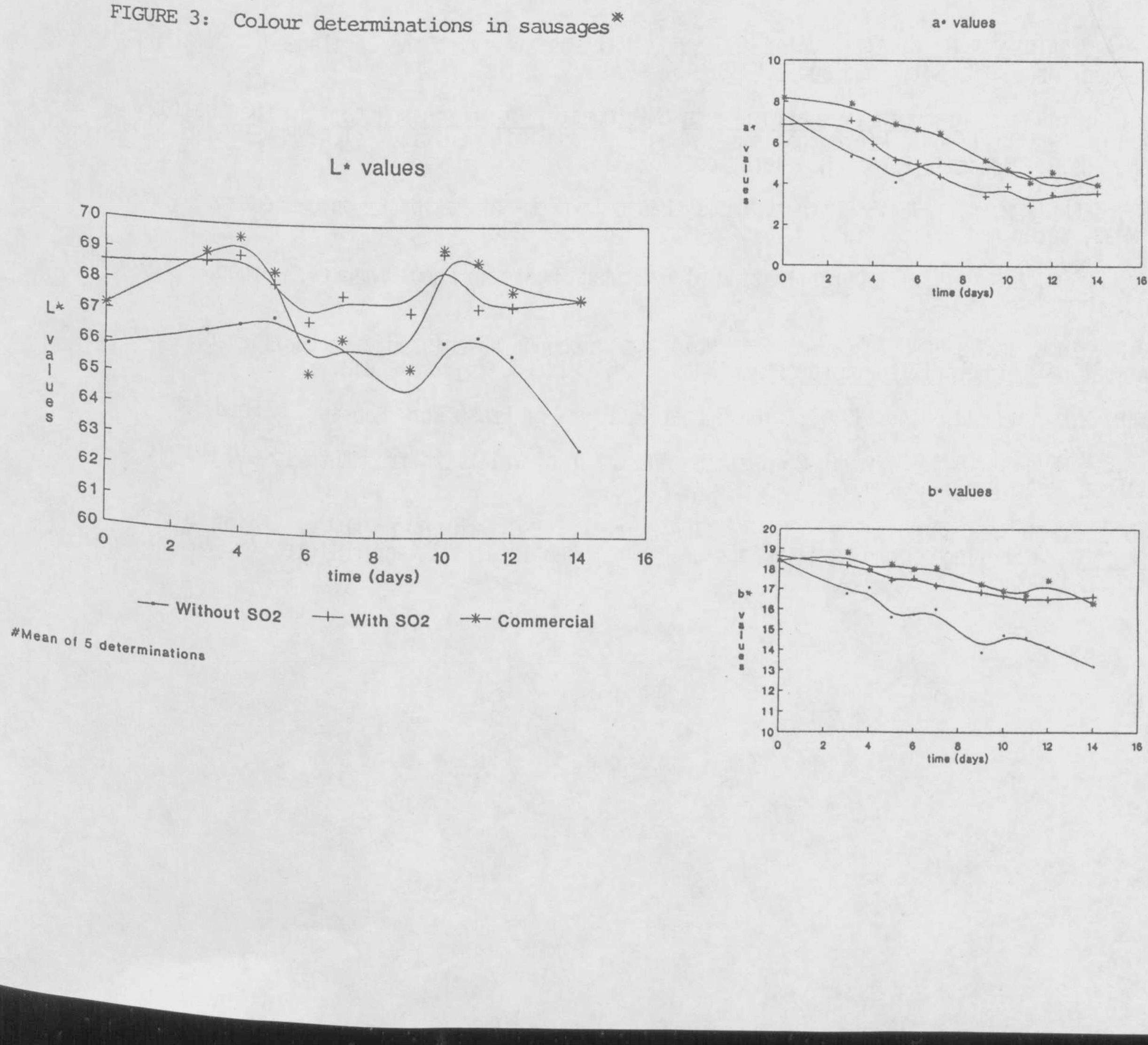
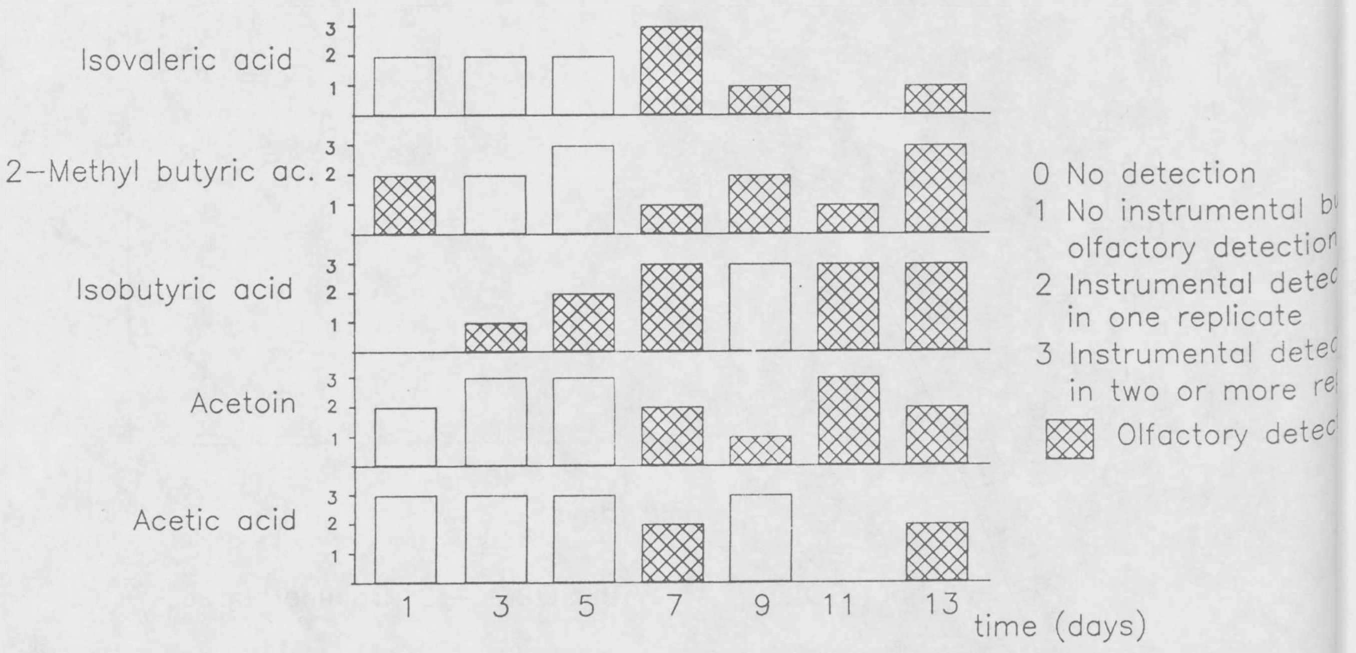


FIGURE 3: Colour determinations in sausages*



#Mean of 5 determinations

Figure 4: Absence, presence and olfactory detection of the target compounds in fresh British style pork sausages through their shelf-life



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