# SULPHIDE EVOLUTION FROM COOKING MUTTON AND BEEF

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## SUMMARY

an and adipose tissue samples from beef and mutton carcasses were cooked and the amount of sulphide evolved was determined. For th species, more sulphide was generated from lean than from adipose tissue over the 2 hour cooking period. This contrasts with results tained by others, that more sulphide is evolved from adipose tissue. Approximately 33% more sulphide was evolved from mutton lean n from beef lean. Large inter-animal differences were observed in evolution rates from mutton adipose tissue, although the average rate s higher than from beef. The amount of sulphide evolved per gram of protein was significantly lower for lean than for adipose tissue of th species. The mutton adipose tissue samples, although differing greatly in sulphide evolution rate, all had a strong, characteristic utton odour after cooking. This suggests that sulphides do not contribute directly to mutton odour.

## INTRODUCTION

nsumers in many of the world's more affluent markets dislike the distinctive flavour and cooking odour of sheepmeat (SMITH & UNG, 1991). World sheepmeat production levels and average prices in international trade are both low compared with beef and pork AO, 1987, 1988), at least in part as a result of this consumer aversion. There is, therefore, a considerable incentive for major sheepmeat porters like New Zealand to produce sheepmeat with odour and flavour characteristics that appeal to a wider market.

lphur-containing compounds have been cited as possible contributors to sheepmeat odour (CRAMER, 1963, 1983; KUNSMAN & LEY, 1975; NIXON *et al.*, 1979; HA & LINDSAY, 1991). However, to date only two published studies have systematically vestigated the contributions of specific sulphur-containing compounds to sheepmeat odour. KUNSMAN & RILEY (1975) found that ipose tissues of beef and lamb gave off much larger amounts of $H_2S$ during cooking than did lean tissues, and that lamb tissues produced ore $H_2S$ than beef tissues. HA & LINDSAY (1991) reported a relatively high concentration of thiophenol (benzene thiol) in volatiles om ovine perinephric fat, causing burnt, sulphury odours that the authors contended could potentiate undesirable mutton flavour notes. hiophenol was absent from bovine, equine, porcine and cervine fat volatiles.

e findings of KUNSMAN & RILEY (1975) have been cited in subsequent publications as evidence supporting the notion that sulphur mpounds contribute to undesirable ovine species flavour. However, compositional data for ovine and bovine adipose tissue indicate that th the total sulphur content and the cysteine/cystine and methionine contents in these tissues are significantly lower than in lean tissues, d we were therefore suspicious of the relatively high sulphide evolution rates from adipose tissues reported by KUNSMAN & RILEY 975). Also, the reported high sulphide evolution rate from sheepmeat compared with beef unexpected, as the total sulphur content of beef d mutton lean tissues is similar (LAWRIE, 1981; CHRYSTALL & WEST, 1989). In this study we re-investigated the evolution of lphide from beef and sheepmeat.

UNSMAN & RILEY (1975) cooked tissues in a manner that simulated preparation of meats for home consumption. We sought to tablish whether comparable results could be obtained for samples cooked at a constant temperature. We boiled the tissue samples, as it is own from related studies in this laboratory (REID *et al.*, 1992) that panellists can easily detect mutton odour from samples cooked at 0°C.

## MATERIALS AND METHODS

***Sheepmeat and beef samples***

Striploins were obtained from three beef and three mutton carcasses. For each animal, adipose and lean tissues were separated connective tissue was trimmed from the lean. Each lot of tissue was ground twice through a 3 mm holeplate, then frozen and stor -35°C until required for analysis.

***Sulphide and protein determinations***

The cooking procedure was adapted from that described by PEPPER & PEARSON (1969). Samples (10 g) were added to 100 ml of in a flask and refluxed at 100°C for 2 hours. The sulphide evolved was swept from the samples in a stream of nitrogen that was bub through traps at a pressure differential of 70 mm of water. The traps were 125 x 12 mm test tubes containing 5 ml of 2% zinc ace solution. Pasteur pipettes were used as distributors. Both pipettes and traps were changed at 20-minute intervals.

A colorimetric method (adapted from RUSSELL, 1984) was used for sulphide determination. The colour-development reagents w added directly to the sulphide traps. After colour development, absorbances were measured at 625 nm.

Protein was determined according to AOAC (1990).

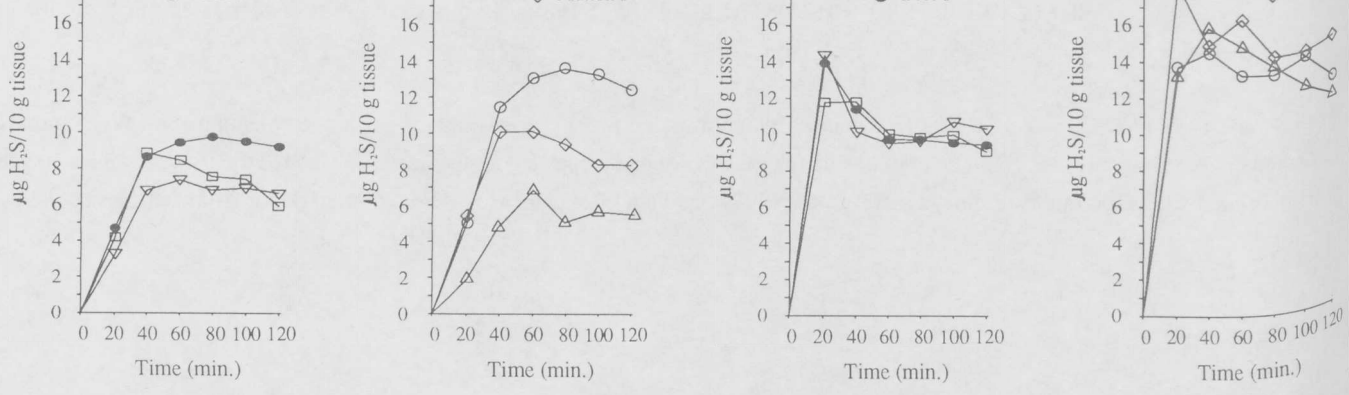
## RESULTS AND DISCUSSION

***Comparison of evolution rates from sheepmeat and beef***

In past studies of sulphide evolution from animal tissues, evolution rates reached a plateau at an early stage of cooking, sometimes aft rapid initial phase (MECCHI *et al.*, 1964, PEPPER & PEARSON, 1969, KUNSMAN & RILEY, 1975). This pattern was also observed our experiments (Fig. 1).

The sulphide evolution rates from tissues in our experiments were in the same range as those reported for boiled chicken muscle MECCHI *et al.* (1964), but were somewhat lower than the rate for boiled beef adipose tissue reported by PEPPER & PEARSON (196 and much higher than those reported by KUNSMAN & RILEY (1975). In the latter case, this may reflect the difference in cook methods used in the two studies. KUNSMAN & RILEY (1975) cooked samples to a relatively low internal temperature (78°C), where our samples were cooked at 100°C.

Figure 1. Sulphide evolution from beef and mutton tissues.



ur experiments, more sulphide evolved from samples of lean than of adipose tissue for both species studied, in contrast with findings by NSMAN & RILEY (1975), who trapped more sulphide from adipose tissue. Approximately 33% more sulphide evolved from mutton than from beef lean. For adipose tissues, the inter-animal variation was too large to permit inter-species comparison (Fig. 1).

phide evolution rates per gram of protein were significantly higher for adipose than for lean tissues for both species (Table 1), indicating a high proportion of the sulphur in adipose tissue is present in a relatively heat-labile form. Mutton lean evolved approximately 40% e sulphide/g protein than beef lean. For adipose tissue the inter-animal variation was again too large to make a valid inter-species parison.

e 1. Protein content and sulphide evolution from beef and mutton lean and adipose tissues. 10 g samples of tissues from three animals were cooked for 2 hours at 100°C, and the amount of sulphide evolved in that time was determined. Data are the mean of determinations for three animals of each species.

| | Protein, % | Sulphide evolution, μg/g protein |
|---|---|---|
| Beef Lean | 22.3 | 28.4 |
| Mutton Lean | 1.5 | 39.3 |
| Beef Adipose | 5.4 | 81.7 |
| Mutton Adipose | 6.1 | 83.8 |

rmal sensory evaluations were carried out by the authors after samples were cooked. All the ovine adipose tissue samples had a strong, inctive mutton odour, although sulphide evolution rates varied widely (Fig. 1).

lean muscle, water-insoluble myofibrillar proteins are the principal source of $H_2S$ (MECCHI *et al.*, 1964, HAMM & HOFFMAN, 5). PEPPER & PEARSON (1969) found that for bovine adipose tissue, most of the $H_2S$ was evolved from the water-soluble fraction, that the sulphur-containing precursors in this fraction were relatively heat-labile. Our results suggest that this is also the case for ovine pose tissue.

ults from past studies have led to speculation that sulphur is stored in ovine adipose tissue in a specialized form not found in other cies (KUNSMAN & RILEY, 1975, CRAMER, 1983, HA & LINDSAY, 1991). CRAMER (1983) hypothesized that such a specialized phur store might exist to maintain wool growth under adverse conditions. We are currently investigating the composition of beef and tton tissues to identify water-soluble precursors of flavour volatiles. We hope that these investigations will provide an insight into the ure of sulphur storage in adipose tissue and the chemistry of the formation of sulphur-containing volatiles.

## ACKNOWLEDGMENTS

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