EFFECT OF SULFUR DIOXIDE ON C. BOTULINUM IN COOKED MEAT

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INTRODUCTION

Recent research (6) has shown sulfur dioxide delays botulinal outgrowth in temperature abused perishable canned comminuted pork. More than 100 µg/g sulfur dioxide was required to cause significant inhibition of a target botulinal spore level of 100/g. The addition of 40 µg/g sodium nitrite reduced the efficacy of sulfur dioxide.

Potential replacements for part, or all, of the nitrite in perishable meat should be evaluated by temperature abuse after a period of typical commercial refrigerated storage (3). The results of two such tests are described. Also, data from five test lots have been compared to learn whether the efficacy of sulfur dioxide is influenced by the level of botulinal spores.

MATERIALS AND METHODS

The C. botulinum inoculum consisted of a mixture of five type A and five type B strains prepared as described earlier (5). The mixed spore suspension was heated at 80C for 15 minutes and added to the meat during formulation to obtain a target level of 100 spores/g of product.

Except as otherwise indicated, perishable canned comminuted pork was formulated, inoculated, processed and chilled as previously described (1). Sodium metabisulfite ($Na_2S_2O_5$; Allied Chemical Corp., New York) was added as the source of sulfur dioxide on the basis of the weight of meat in the formulation. Since it has been reported that sodium metabisulfite yields about 67% sulfur dioxide (2), 296 µg/g of sodium metabisulfite was added to obtain 200 µg/g of sulfur dioxide. Sodium nitrite was added at a level of 40 µg/g on the basis of the weight of meat in the formulation. Sodium isoascorbate was omitted in these tests. Product was formulated with a) 50, 100 or 200 µg/g sulfur dioxide, alone, or b) 200 µg/g sulfur dioxide plus 40 µg/g sodium nitrite. Twenty-five cans of each variable were placed at 27C after storing at 4.4C for 0, 10 or 26 weeks.

The first five cans to swell at 27C were assayed for toxin as described earlier (6). In these tests, 63 out of 65 samples tested were toxic.

The effect of spore level on the antibotulinal efficacy of sulfur dioxide was determined by comparing data from five test lots performed since 1978. The data consisted of product formulated with 200 µg/g sulfur dioxide, alone, and a target level of 100 spores/g of product. Spore levels were determined using a three tube MPN procedure as previously described (1). The spore levels remaining after processing were 27, 49, 124, and 310/g. These estimates are geometric means from 6 cans analyzed in one test (49), 9 cans in two tests (27 and 310), and 5 in the fourth test (120). The product having 310 spores/g were tested in duplicate with two separately prepared batches of product.

RESULTS AND DISCUSSION

Data in Figure 1 show that holding product for 10 weeks at 4.4C did not alter the patterns of inhibition during subsequent abuse at 27C when 50, 100 or 200 µg/g of sulfur dioxide were added.

Data in Figure 2 shows the addition of 40 µg/g of sodium nitrite significantly reduced the antibotulinal efficacy of 200 µg/g of sulfur dioxide. There appears to have been further loss of inhibition as this product was held for 10 and 26 weeks at 4.4C prior to abuse. Product formulated with 200 µg/g of sulfur dioxide, alone, showed varying degrees of inhibition when abused after 0, 10 or 26 weeks at 4.4C; although, substantial botulinal inhibition existed even after 10 and 26 weeks of refrigerated storage.

Considerable variation in the degree of botulinal inhibition was observed in five test lots prepared since 1978 with 200 µg/g of sulfur dioxide (Figure 3). In each test the target botulinal spore level was 100/g and with nitrite and isoascorbate being omitted from the formulation. Considerable variation in inhibition has been reported for sodium nitrite when tested under similar conditions (3, 4). One possible explanation for the variation in the product prepared with 200 µg/g of sulfur dioxide is the level of spores remaining after processing. The two lots having the highest level of spores (310/g) showed less inhibition than product with the lowest level of spores (27 and 49/g).

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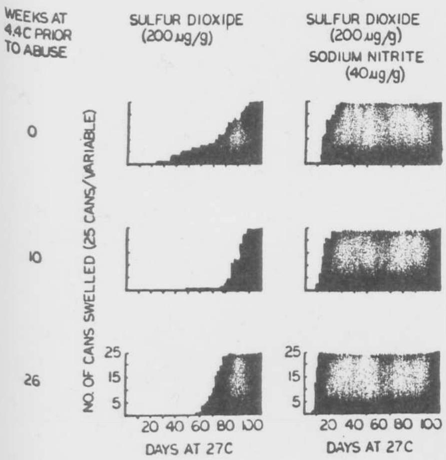
FIGURES

Fig. 1. Effect of refrigerated storage prior to temperature abuse on botulinal inhibition in perishable canned cured pork formulated with sulfur dioxide (200 μg/g) or sulfur dioxide (200 μg/g) plus sodium nitrite (40 μg/g) and a target level of 100 spores/g.

Fig. 2. Effect of refrigerated storage prior to temperature abuse on botulinal inhibition in perishable canned cured pork formulated with sulfur dioxide (50, 100, or 200 μg/g) and a target level of 100 spores/g.

Fig. 3. Effect of botulinal spore level on inhibition in perishable canned cured pork formulated with 200 μg/g sulfur dioxide. Spore levels remaining after processing were 49, 27, 310, 124, and 310, respectively, counterclockwise from top right figure. Product was placed at 27C on the day of manufacture.



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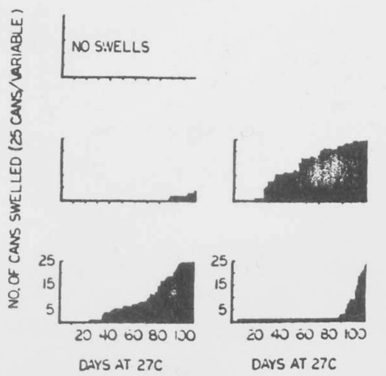

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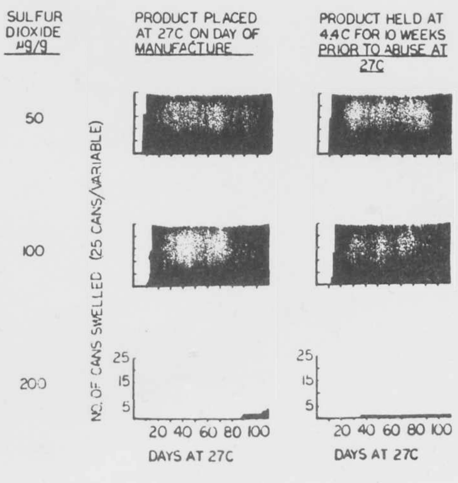

2.