

It may be hoped that the realities of present-day measurement technique will eventually lead to both the meter and the astronomical unit being defined in terms of the far more fundamental measure, the light-second. Perhaps then the present confusion will abate.

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### Botulism and Nitrites

In their article of 7 July 1972 (p. 15), I. A. Wolff and A. E. Wasserman imply that the addition of nitrite is necessary to prevent the growth of *Clostridium botulinum* in cured meat and smoked fish products. In fact, the conjunction of many factors, of which nitrite is only one, produces the bactericidal effect. It is not known what other combinations of heat, salt, and pH might accomplish the same effect in the absence of nitrite.

What is known is that many products, such as bacon, to which nitrites are now added, involve no botulism hazard because they are fried. Others, such as frankfurters, can be processed without nitrite to remove any such hazard. The Berkeley Co-Op, for example, has marketed such a product for some time with great success. As the Fountain subcommittee hearings in March 1971 demonstrated, the use of nitrite in the processing of smoked fish products is a relatively recent practice, and the levels added are frequently far below what the Food and Drug Administration claims to be necessary to prevent botulism. In fact, some states prohibit the addition of nitrate or nitrite to smoked fish products and instead require processing at 180°C to obviate any botulism risk. Japan has totally banned the use of nitrites in fish products.

While it is true that some early reports of *N*-nitrosamines in foods are of questionable validity, some more recent positive findings have been confirmed. For instance, the presence of the carcinogen nitrosopyrrolidine in cooked bacon and sausage has been confirmed at between 30 and 106 parts per billion. The very limited number of samples for nitrosamines taken by the U.S. Department of Agriculture makes any positive findings in the food supply highly suggestive.

It is true that "there is not enough information" to determine the probability of nitrosamine formation in vivo in humans. Nevertheless, nitrosamine formation from the interaction of nitrites and secondary amines have been established in vivo in cats and rabbits, species whose gastric juices have a pH similar to that of man. And the presence of nitrosodiphenylamine was detected in the stomachs of 31 human subjects who were fed a combination of nitrate and secondary amines (1).

It is precisely the numerous uncertainties and gaps in knowledge about nitrites and nitrosamines which Wolff and Wasserman identify that compel one to disagree with their conclusion that "the hazard is not sufficiently great to cause alarm." Apparently, they would have an unsuspecting public bear the burden of these uncertainties, despite ample evidence that nitrites are not always necessary to prevent botulism and that alternative means of safe processing are available which do not involve risks such as those posed by nitrite. The law and common sense both require that these risks be resolved.

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1. P. N. Magee, *Food Cosmet. Toxicol.* **9**, 207 (1971).

Schuck and Wellford are to be commended on their concern for the consumer. We, too, share this concern. We also are in accord with the last sentence of their letter. However, we repeat our contention that the resolution of the risks must be based on considered evaluation of all the information available. Furthermore, sufficient foresight must be applied to prevent undesirable effects induced by any changes imposed. Our article was a brief compilation and summary of information from several diverse fields to provide a background, as well as to stimulate thought, interest, and research on a sensitive problem of public health interest. Schuck and Wellford have used in part data published since our paper was prepared to question our conclusions. In the same interval, however, a number of encouraging reports have also appeared, as we indicated they might. Van Logten *et al.* (1) reported

no tumors or cancerous lesions in rats fed for 2 years on a diet consisting of 40 percent cured meat processed with nitrate in such a manner that 60 micrograms per kilogram (parts per billion) of total nitrosamines were found in the meat. In our laboratory, sodium ascorbate was shown to inhibit or prevent the formation of *N*-nitrosodimethylamine in frankfurters (2), and preliminary data indicate *N*-nitrosopyrrolidine formation in bacon may be similarly affected. Modification of manufacturing practices may be required when these results, together with information from other laboratories, are evaluated.

One alternative proposed by Schuck and Wellford does not seem acceptable. According to them, many products, such as bacon, could contain botulin toxin, but there would be no hazard because they are fried prior to consumption. We question whether appropriate regulatory agencies would be willing to approve such products. Consumers and consumer organizations themselves might want to raise serious questions about such an approach.

The urgency stressed by Schuck and Wellford about elimination of nitrate should, in our opinion, be tempered with caution, in view of the many scientific unknowns and the long history of usage with apparent safety. There is still no correlation of the quantities of nitrosamines that might possibly be ingested under normal conditions with the development of harmful effects—either in humans or in animals. The nitrosamines pose a serious *potential* hazard, and intensive investigation of the many facets of the problem is definitely needed and under way. At this time a satisfactory solution to the problem looks promising. This may involve modifications of curing processes, utilization of nitrite substitutes, reduction of nitrite concentration, or in some cases elimination of nitrite. To us it seems somewhat premature to judge the preferred approach or approaches.

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