C54

CURRENT CONTENT OF RESIDUAL NITRITE IN CURED MEAT PRODUCTS AT THE RETAIL MARKET

ROBERT G. CASSENS
Meat Science & Muscle Biology Laboratory
University of Wisconsin
Madison, Wisconsin 53706

BACKGROUND: Sodium nitrite is the critical ingredient used in the process of manufacturing cured meat. During the curing process sodium nitrite undergoes numerous reactions that result in a number of nitrosated reaction compounds, plus some remaining unreacted nitrite identified as residual nitrite. The end product is influenced by the properties of the biologically complex meat matrix as well as conditions of manufacture. In addition, subsequent changes in the product may occur during storage, distribution, retail display and final preparation of the cured meat.

During the 1970's, there was concern that consumption of cured meat represented a health risk for humans. This anxiety arose from the knowledge that some N-nitroso compounds, especially some nitrosamines, are carcinogens, and it was thought that ingestion of (residual) nitrite could lead to nitrosation reactions in the human body. This concern needed to be balanced against the fact that nitrite in meat functions as an important preservation agent, especially against *Clostridium botulinum*.

Analytical efforts revealed that levels of volatile N-nitrosamines were quite low and that residual nitrite levels were extremely variable, but for the most part rather low. Changes initiated by the industry, such as lowering the amount of ingoing nitrite, use of reducing agents, and improved process control resulted in improvements (i.e. lower levels of nitrosamines and residual nitrite). In addition, it was discovered that endogenous synthesis of nitrite occurs in the body.

Two reports published by the National Academy of Sciences (1981, 1982) helped to alleviate public concern about cured meat as a human health risk. Since then, tracking of sources nitrite intake, especially foods, has been more active in other countries than in the USA.

Cassens (1990, 1995) has published complete accounts about nitrite cured meat and historical perspectives of the problem.

Recently, interest in cured meats resurfaced when a link between consumption of hot dogs and childhood cancer, based on epidemiological studies, was reported. Sarasua and Savitz (1994) showed positive associations between brain tumors and childhood consumption of ham, bacon, and hot dogs. Peters et al. (1994) reported a persistent association between children's intake of hot dogs and the risk of leukemia. In a case-control study of maternal diet during pregnancy and risk of childhood brain tumor Bunin et al. (1994) observed a trend for consumption of cured meats to be associated with increased incidence of tumors.

As a result of these finding, it became immediately important to reinvestigate residual nitrite in cured meat. The manufacture of cured meat in the USA has undergone considerable change during the past fifteen years, and residual nitrite values have not been reported in the literature.

OBJECTIVE: The objective of this investigation was to establish residual nitrite level in cured meat. Such information would provide modern values for comparison with historical data used to calculate human intake values for nitrite from various sources.

METHODS: Retail packages were purchased up from a local supermarket; the only selection criterion was that the products must be within the code date. Three product categories of bacon, sliced ham and hot dogs were selected. Bacon included three different manufacturers, sliced ham included three different manufacturers, and hot dogs included four different manufacturers. The ten refrigerated packages were delivered to the analytical laboratories of Hazleton-Wisconsin where residual nitrite was determined according to method 973.31 (AOAC, 1990). Results are expressed as ppm of nitrite ion.

RESULTS:
Bacon as 4, 1 and 15 ppm of nitrite
Sliced ham as 3, 9 and 7 ppm of nitrite
Hot dogs as 1, 4, 1 and 9 ppm of nitrite

DISCUSSION: It is obvious that the present residual nitrite levels in retail cured meats are low; the mean in this case, is 5.4 ppm. In 1975, White concluded that "Two-thirds of the nitrite entering the average stomach originates in saliva and slightly less than one-third comes from cured meats." He used an average residual nitrite content for cured meats of 52.5 ppm. Our current results are 1/10 of the values he used.

The calculations by White (1975) utilized data from several sources including early work in 1936 and from several reports in the early 1970's. Interestingly, the 1972 data he used had a range in residual nitrite for franks of 0-195 ppm.

A 1977 report (anonymous) provides insight into the trends underway in the meat processing industry at that time. In regard to their products, a major meat processor reported that, "When the average nitrite content (9 ppm) of these products at 1-4 days of age is substituted for the 52.5 ppm used by White, the contribution to dietary nitrite intake falls to 7%. Two weeks after packaging, these products contain only enough residual nitrite to contribute about 2.5% to dietary intake of nitrite."

CONCLUSION: Changes in the manufacture of processed meats have resulted in retail products with a current residual nitrite content of about 5 ppm. This amount is considerably lower than the values reported (and recorded in the literature) approximately twenty years ago. The current results, together with an appreciation of modern information about endogenous synthesis of nitrite, should be considered in estimating the contribution of various sources to human intake of nitrite.

ACKNOWLEDGEMENTS: This work was supported by the College of Agricultural and Life Sciences, University of Wisconsin and by contributions from the American Meat Institute. Muscle Biology Laboratory manuscript # 342.

REFERENCES: Anonymous. 1977. Residual sodium nitrite in Oscar Mayer & Co. products. Presented to the May 31, 1977 Meeting of USDA Expert Panel on Nitrites and Nitrosamines. Washington, D.C.

AOAC. 1990. Official Methods Of Analysis. 15th edition. Arlington, Virginia.

Bunin, G. R., R. R. Kuijten, C. P. Boesel, J. D. Buckley and A. T. Meadows. 1994. Maternal diet and risk of astrocytic glioma in children: a report from the Childrens Cancer Group (United States and Canada). Cancer Causes & Control. 5, 177.

Cassens, R. G. 1990. Nitrite Cured Meat: A Food Safety Issue In Perspective. Food & Nutrition Press, Inc. Trumbull, CT.

Cassens, R. G. 1995. The use of sodium nitrite in contemporary cured meat. (submitted).

National Academy of Sciences. 1981. The health effects of nitrate, nitrite, and N-nitroso compounds. National Academy Press, Washington, D.C.

National Academy of Sciences. 1982. Alternatives to the current use of nitrite in foods. National Academy Press, Washington, D.C.

Peters, J. M., S. Preston-Martin, S. J. London, J. D. Bowman, J. D. Buckley and D. C. Thomas. 1994. Processed meats and risk of childhood leukemia (California, USA). Cancer Causes and Control. 5, 195.

Sarasua, S. and D. A. Savitz. 1994. Cured and broiled meat consumption in relation to childhood cancer: Denver, Colorado (United States). Cancer Causes and Control. 5. 141.

White, J. W. 1975. Relative significance of dietary sources of nitrate and nitrite. J. Ag. Food Chem. 23, 886. (see correction in J. Ag. Food Chem. 24, 202, 1976).