Nitrite and the flavour of cured meat II

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Abstract

A review of the literature of the last 50 years shows very little interest in the effect of nitrite on flavor of cured meat products, particularly the relation of sodium nitrite to development of the flavor. Sensory evaluation studies indicate a need for the presence of nitrite; low concentrations may be sufficient to induce the flavor. Chemical analysis of head space vapors or extracts of cured hams has led to identification of up to approximately 50 compounds. Although many of them have been identified before in other meats or fowl, none has the characteristic cure aroma. Known reactions of nitrite and various meat components are discussed.

Introduction

Investigations into the role of nitrite in the cure process have been principally on the development of color and on the preservative, anti-clostridial effect. Authorization for the use of nitrite in cured meat as described in the U.S. Code of Federal Regulations (1971) is for the purpose of developing color. Recent reports, (Wolff & Wasserman, 1972), however, suggest a re-appraisal of the curing process because the nitrite may under some conditions react with amino compounds present to give small concentrations of nitrosamines. It is now being recognized what has been evident for many years: without the use of nitrite, the characteristic cured flavor is not developed in meat products. However, since 1940 very limited research has been carried out on this problem. The studies that have been reported can be classified either as processing and sensory evaluation products or chemical analysis of the reaction between nitrite and meat components. Insufficient information is available in either of these categories to permit a definitive discussion of the role of nitrite in the development of cure flavor, but this paper can serve to consolidate reported data and place them in a perspective that may encourage an increase in research activity.

Processing and sensory evaluation of meat products

The studies of Kerr et al. (1926), which established the basis for the use of nitrite in curing meat products, demonstrated that nitrite-cured meat was as acceptable as traditionally cured meat. Although flavor was not specifically men-

tioned in the report, it must be assumed that this was a consideration in the quality assessment of the products. Brooks et al. (1940) investigated the use of nitrite in the Wiltshire bacon curing process, particularly with respect to flavor formation. Although no sensory evaluation data were given and the responses appear vague, the authors concluded that the characteristic flavor of bacon and ham (as opposed to salt pork) is due to the reaction of nitrite with tissue constituents during curing or during cooking and that 10 mg NO_2^-/l cure was sufficient to give satisfactory flavor.

Barnett et al. (1965), in an extensive study of the development of ham flavor, found that hams pumped with pickle containing 0.1 g NO_2^-/l were as acceptable to a panel as those pumped with the normal pickle containing 1.5 g NO_2^-/l; the former value being equivalent to about 10 mg nitrite per kg. ham.

Unfortunately these authors did not compare hams without nitrite, but their data show that lower values can be used successfully. Tripling the normal concentration of nitrite in the pickle resulted in hams with bitter flavor.

Pork m. longissimus dorsi roasts, cured with 300 mg nitrite/kg but not smoked, could be distinguished in triangle taste tests from those cured without nitrite, and in paired comparison tests the panelists indicated the nitrite-treated products had more cure flavor (Cho & Bratzler, 1970). Smoking the cured roasts did not affect the outcome of the taste tests; nitrite-treated roasts were still differentiated in the triangle test and had more cure flavor.

More recently, Simon et al. (1972) found all meat frankfurters made with beef and pork were scored low in a hedonic taste panel evaluation when they contained no nitrite; 39 mg nitrite/kg, the lowest concentration tested, was sufficient to give an acceptable flavor. For some unexplained reason, however, all beef frankfurters were acceptable even in the absence of nitrite. It should be noted that in these studies the panelists were asked whether they liked or disliked the product – not how much cure flavor it contained.

In our laboratory, we (Wasserman & Talley, 1972) found the role of nitrite in frankfurter flavor to be complex, depending on the type of evaluation panel used. In triangle tests with both smoked and unsmoked frankfurters, there were significant differences between products prepared with or without 156 mg nitrite/kg (Table 1). However, in tests in which 'frankfurter' flavor was scored, the smoked, non-nitrite-treated sample was rated as highly as the cured sample. Analysis of variance showed an interaction between smoke and nitrite. Thus, while there is no question about the poor flavor of non-nitrite-, non-smoke-treated samples, cured franfurter flavor is also associated with smoke flavor.

Chemical studies

Ockerman et al. (1964) felt that since the aroma of dry cured ham was similar to its flavor, analysis of volatile components would identify the flavor factors. Vacuum distallates of ham cured with salt, sugar, and KNO_3 had a typical aroma and flavor; a number of carbonyls, acids, and bases were identified. While none were specifically associated with cured flavor, it was noted that the quantity of acids and carbonyls increased with the age of the ham.

Ockerman et al. (1964) felt that since the aroma of dry cured ham was similar to palmitoleic, oleic, and linoleic – decreased, first during curing and smoking, then