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# Chemical behaviour of nitrite in meat products. 2. Effect of iron and ethylenediaminetetraacetate on the stability of protein-bound nitrite

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## Abstract

Addition of $Fe^{2+}$ at 0.1 or 1 mmol $kg^{-1}$ resulted in higher contents of protein-bound nitrite (PBN) in the stored product, whereas EDTA has the opposite effect. The effect was more pronounced at pH 6.2 than at 5.65, and was completely absent at pH 5.1.

## Introduction

Addition of ferrous sulfate to meat products increased the content of protein-bound nitrite during storage of the product (Olsman & Krol 1972). It was supposed that a ferric coordination complex was formed with cysteine residues and NO like those described by van Roon (1974). However our observations were limited to a model product of pH 6.3. This report provides data on the effect of ferrous ions and the metal chelator ethylenediaminetetraacetate (EDTA) on contents of protein-bound nitrite in three model meat products with pH ranging from 5.10 to 6.20.

Table 1. Amounts of additives to 1 kg of the basic emulsion, and treatment of 12 products. GDL, glucono-δ-lactone; EDTA, ethylenediaminetetraacetate.

| Product | GDL | $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$ | | $Na_2EDTA$ | | Heating temp. (°C) | pH of final product |
|---|---|---|---|---|---|---|---|
| | (g) | (mg) | (mmol) | (g) | (mmol) | | |
| D | – | – | – | – | – | 105 | 6.19 |
| E | 7.3 | – | – | – | – | 85 | 5.66 |
| F | 14.6 | – | – | – | – | 70 | 5.11 |
| G | – | 39.1 | 0.1 | – | – | 105 | 6.19 |
| H | 7.3 | 39.1 | 0.1 | – | – | 85 | 5.66 |
| J | 14.6 | 39.1 | 0.1 | – | – | 70 | 5.10 |
| K | – | 39.1 | 1.0 | – | – | 105 | 6.17 |
| L | 7.3 | 39.1 | 1.0 | – | – | 85 | 5.66 |
| M | 14.6 | 39.1 | 1.0 | – | – | 70 | 5.10 |
| N | – | – | – | 1.86 | 5 | 105 | 6.15 |
| P | 7.3 | – | – | 1.86 | 5 | 85 | 5.63 |
| Q | 14.6 | – | – | 1.86 | 5 | 70 | 5.07 |

## Materials and methods

### *Preparations of model products*

Table 1 shows amounts of additives and heat treatments of 12 portions of the basic emulsion of the same composition as in Part 1, Table 1. The additives were distributed uniformly as in Part 1. The ferrous ammonium sulfate and the EDTA were dissolved in part of the water used for the preparation of the emulsion. The EDTA solution was adjusted to pH 6.3 with sodium hydroxide. The 12 batches were canned as in Part 1. Heating temperatures are given in Table 1. All products were stored at 15 °C.

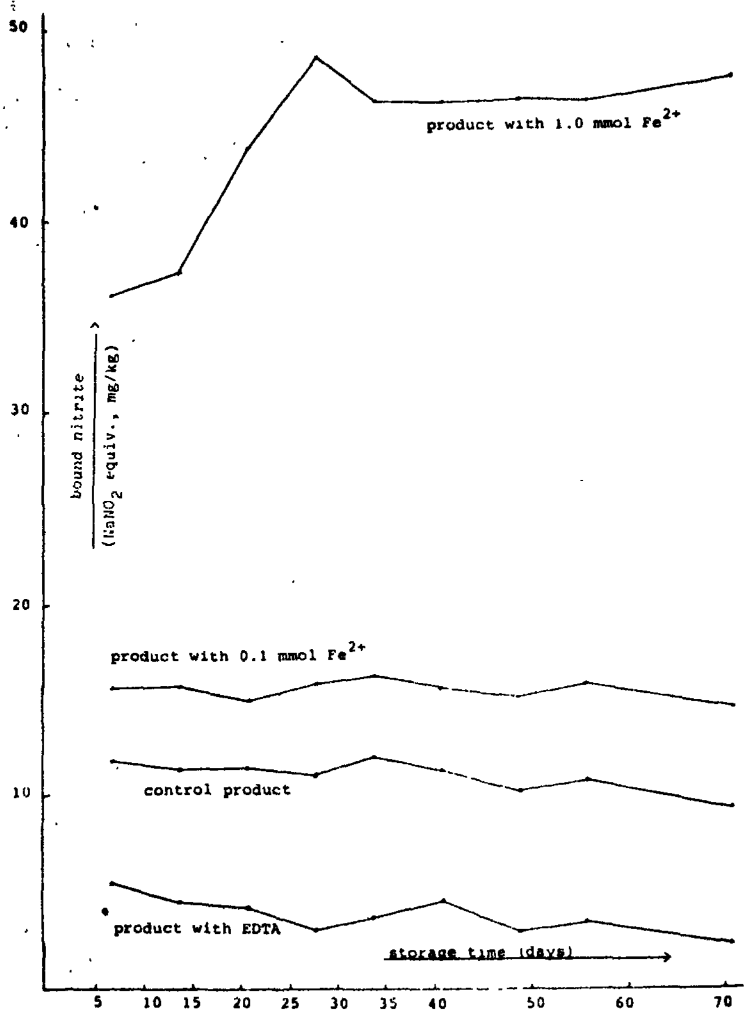


Fig. 1. Changes in bound nitrite level during storage of products of pH ≈ 6.2



### *Analytical method*

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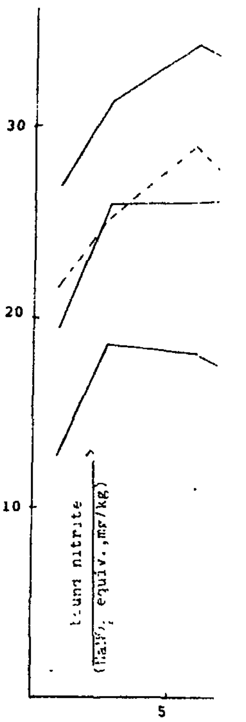


Fig. 2. Changes in bo

*Analytical method*

Protein-bound nitrite was estimated as in Part 1.

**Results and discussion**

Figures 1, 2 and 3 show the changes in bound nitrite during storage at 15 °C in the control products with iron at 0.1 and 1 mmol $kg^{-1}$ and with EDTA at pH 6.18, 5.65 and 5.10, respectively. The average levels generally increased markedly with decreasing pH.

At pH 6.18, addition of ferrous ions markedly increased content of bound nitrite (Fig. 1). In the product with ferrous ammonium sulphate at 0.1 mmol $kg^{-1}$, the content was 30% more than in control product, hardly changing during storage. In the product with 1.0 mmol $kg^{-1}$, bound nitrite was four times as high, rising considerably during the first 3 or 4 weeks, and then remaining almost constant. Bound nitrite tended to decrease slightly in the control product. With EDTA, endogenous ferrous ions and various other metal ions would be tightly bound in complexes, and the bound nitrite was only 30–40% of that in the control products, declining during storage.

The products of pH 5.65 behaved the same, though less pronouncedly (Fig. 2).

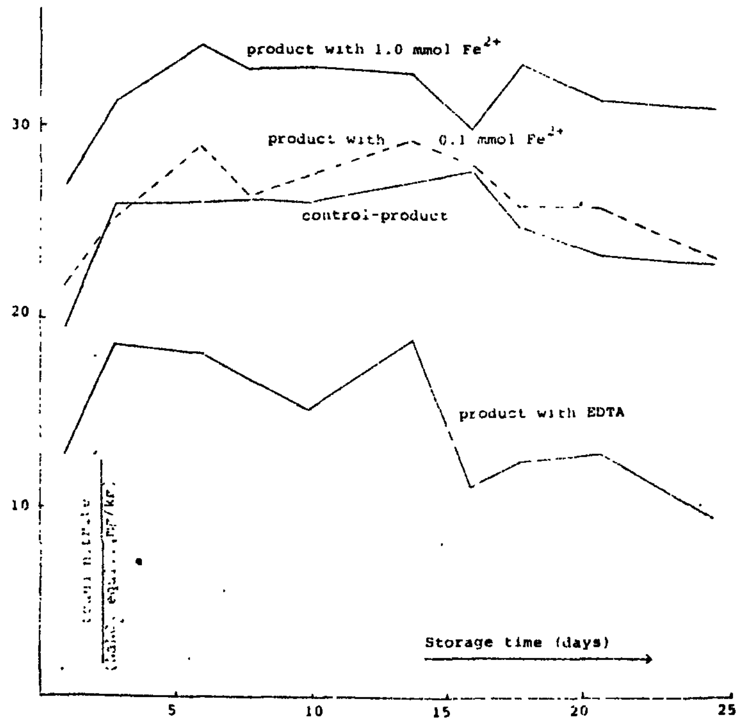


Fig. 2. Changes in bound nitrite level during storage of products of pH ≈ 5.65

With $Fe^{2+}$ 1 mmol $kg^{-1}$, bound nitrite was only 30% higher than in the control product, and with, EDTA, the content was 50 to 60% of that in the control. There were hardly any differences in content of bound nitrite between the four products of pH 5.10 (Fig. 3). With $Fe^{2+}$ 1 mmol $kg^{-1}$, the content was even slightly lower than in the control product. Moreover, in all 4 products, contents decreased markedly during storage.

Evidently the stabilizing effect of iron ions on bound nitrite is strongly pH-dependent, and disappears at a pH as low as 5.1.

Depletion rate of free nitrite was not significantly influenced by EDTA or ferrous ions.

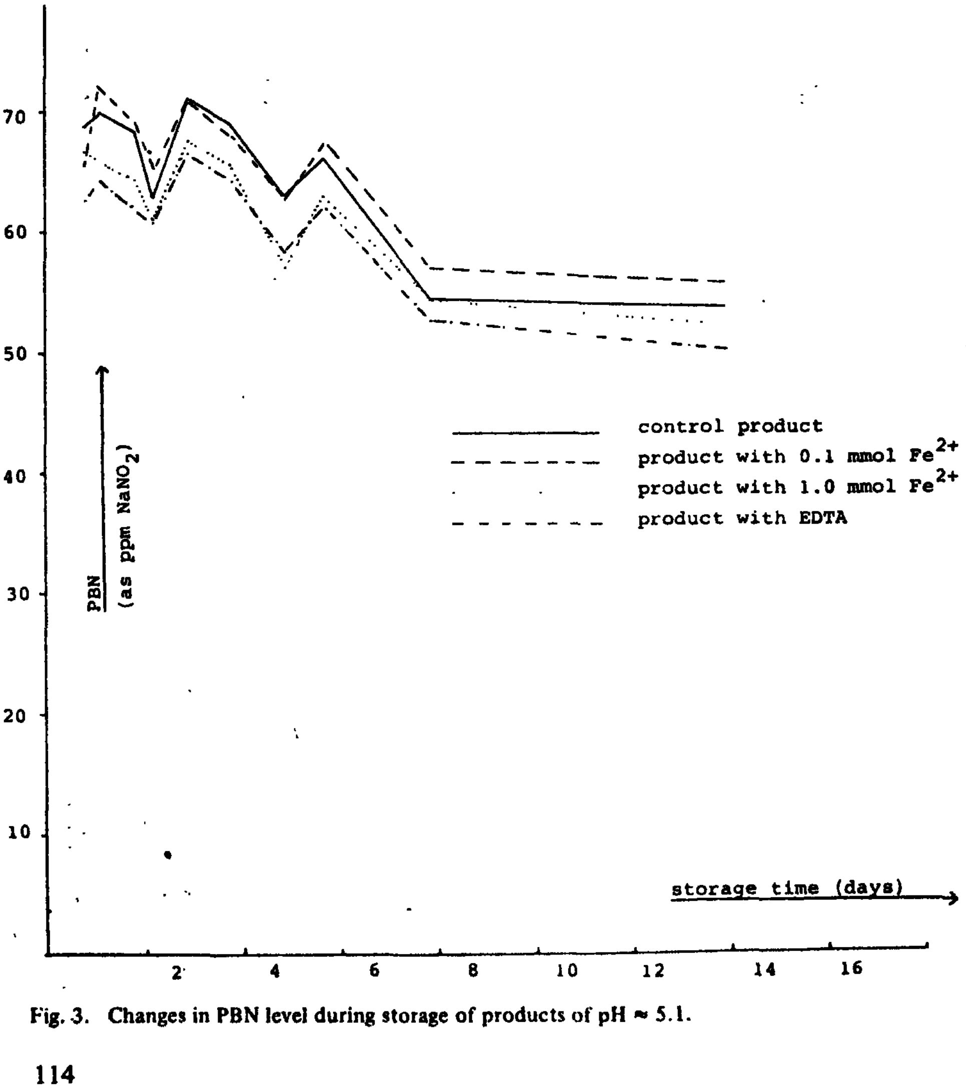


Fig. 3. Changes in PBN level during storage of products of pH ≈ 5.1.