Note

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Improving the stability of nitrite in food extracts

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Abstract

Standard Methods for the Analysis of nitrite can be inaccurate because of the instability of nitrite. Therefore, calibration curves need to be plotted for each new sample, and processing many samples is time consuming. To overcome these issues, we examined the use of additives in extracts to improve the stability of nitrite during extraction and quantification processes.

Oxidizing agents (hydrogen peroxide, potassium nitrate, and potassium permanganate), reducing agents (ascorbic acid, glucose, sodium oxalate, and sodium sulfite), chelating agents (cyclohexanediaminetetraacetic acid, and EDTA) that can suppress oxidation by metal ions, and an organic solvent (chloroform) than can suppress oxidation and reduction by microorganisms were selected as additives. For each additive, a series of ten-fold dilutions from a 1 M stock solution were used to prepare a range of solutions with concentrations between 0.01 M and 10^{-7} M, except for chloroform, which was used at a volume fraction of ≥ 1%. First, we investigated if these additives inhibited color development in the Griess reaction. Next, we evaluated if the additives suppressed decomposition of nitrite in standard solutions stored for 1 week. Finally, we investigated suppression of nitrite decomposition in actual food extracts stored for 1 month. Optimum quantitation of nitrite was possible for extracts stored for ≥ 2 weeks when EDTA was added to them at 0.01 M.

Keywords : food additive, sodium nitrite, stability

I Introduction

Sodium nitrite is a used as a food additive for color development. The nitrite ion (NO_2^-) from this compound binds with hemoglobin and myoglobin in meat and produces a bright red color. This can make food appear fresh and improve its consumer appeal. Sodium nitrite also suppresses reproduction of pathogenic *Escherichia coli* O157:H7 and *Clostridium botulinum* and helps to prevent contamination of food with these bacteria[1-4]. However, it also binds with amines in foods to form toxic nitrosamines, causes methemoglobinemia, and is carcinogenic[5, 6]. Therefore, intake of excess sodium nitrite can be damaging to human health, and the lowest amount possible should be added to food products to achieve the required color. The allowed levels for use of nitrite are ≤ 0.07 g/kg for processed meat products such as sausage and ham, and ≤ 0.005 g/kg for fish eggs such as salmon and herring roe[7].

Methods for the extraction of nitrites from food and quantification of the nitrite concentrations are stipulated in the Methods of Analysis in Health Science[7]. These methods focus on nitrite rather than sodium, because although sodium nitrite is an accepted food additive, cheaper potassium salts that show similar color development and toxicity are sometimes used. However, nitrite has poor stability[8]. It is converted to nitrate under oxidization by air or metals, and can be reduced to ammonium by reductases in bacteria[9-13]. These transformations are more likely to occur in solution after extraction of nitrite than in the solid food product. Therefore, to accurately measure the nitrite concentration, the extraction and quantification processes should be rapid. In addition, a calibration curve needs to be plotted for each new sample, which makes this method unsuitable for simultaneous analysis of multiple samples.

In this report, we investigated using additives in the extracts to suppress nitrite redox reactions and allow for long-term storage of extracts. This could allow for simultaneous

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