Development of an analytical method for copper chlorophyll and sodium copper chlorophyllin in processed foods

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Abstract

The food colourants copper chlorophyll (CuCh) and sodium copper chlorophyllin (CuCh-Na) are used worldwide in a wide range of processed foods. We developed an analytical method for the determination of CuCh/CuCh-Na levels in processed foods to effectively monitor the appropriate use of these colourants. The proposed analytical method involves simultaneous extraction and parallel analysis of hydrophobic CuCh and hydrophilic CuCh-Na without potentially harmful solvents. CuCh/CuCh-Na were extracted from processed foods with 1-butanol and ethyl acetate. CuCh-Na was extracted from the initial extraction solvent with 0.15 mol/L NaOH, and then the residual extraction solvent and alkaline water layers were dried. Finally, the samples were carbonized with H2SO4. The carbonized samples were ashed in a muffle furnace at 480°C. The residue was dissolved in 0.1 mol/L HNO3, and the level of copper in the samples was determined using atomic absorption spectrophotometry to indirectly quantify the levels of CuCh and CuCh-Na. Recoveries of CuCh and CuCh-Na from spiked samples were in the range of 70.7%-80.8% and 55.6%-72.3% (except for white chocolate, at 50%), respectively, with standard deviations in the range of 1.7%-5.0% and 1.5%-7.8%, respectively. In commercial processed foods, the levels of CuCh and CuCh-Na ranged from ND (not detected) to 3.7 mg/kg and from ND to 8.0 mg/kg as copper, respectively.

Keywords: copper, chlorophyll, chlorophyllin, atomic absorption spectrophotometry, food colourant

I Introduction

The green food colourants copper chlorophyll (CuCh) and sodium copper chlorophyllin (CuCh-Na) are made from natural plant chlorophyll. CuCh/CuCh-Na are bright green in colour and are more heat and light stable than natural plant chlorophyll. Because of the beneficial properties of these colourants, they are used worldwide in a wide range of processed foods.

The safety of CuCh/CuCh-Na as food colourants was evaluated by the Joint FAO/WHO Expert Committee on Food Additives (JECFA), and acceptable daily intakes (ADIs) of CuCh (0-15 mg/kg bw/day) and CuCh-Na (0-15 mg/kg bw/day) were also established1, 2). Based on these values, the Codex Alimentarius Commission sets the maximum use levels (MULs) of colourants for 57 categories of processed foods, such as cheeses, mustards, and snacks. The MULs are broadly defined as the levels of CuCh/CuCh-Na (15-700 mg/kg) or as the levels of copper (6-100 mg/kg)3). However, the levels of CuCh/CuCh-Na are governed by divergent regulations issued by multiple regulatory agencies. European parliament and Council directives allow for the quantum satis use of CuCh/CuCh-Na in a small range of processed foods, such as cheeses, vegetables, vinegars, and jams4, 5). In Japan, CuCh/CuCh-Na use is permitted in a small range of food categories (seaweeds, preserved vegetables or fruits, syrups, chewing gums, fish

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