

Enrichment factors of aflatoxin M₁ in dairy products for making naturally and artificially aflatoxin M₁ contaminated milk

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Abstract

Aflatoxin M₁ (AFM₁) is a mycotoxin which frequently contaminates milk and dairy products. AFM₁ is known to be transferred into dairy products, such as cheese, cheese whey, and butter from milk. A number of transfer tests of AFM₁ into cheese have revealed that AFM₁ is transferred and enriched at a specific ratio (enrichment factor [EF]: concentration of AFM₁ in dairy product/concentration of AFM₁ in milk) that varies depending on the kind of cheese. However, few reports have so far investigated the differences regarding types of contamination in raw milk (e.g. naturally or artificially contaminated) on the EF of the cheese. We examined the effect the contamination situation on the EF in Gouda cheese, which is the most produced natural cheese in Japan. The cheese was made from milk either naturally or artificially contaminated with AFM₁, and the concentration of AFM₁ was analyzed using a validated sensitivity method which we recently developed. The EF of Gouda cheese made from milk artificially contaminated with AFM₁ at 0.5, 1.0, and 2.0 µg/L was calculated as 2.80, 3.06, and 2.68, respectively, while that made from milk naturally contaminated with AFM₁ at 0.49 µg/kg was 5.01. The EF of cheese whey was 0.60, 0.60, and 0.55 in milk artificially contaminated with AFM₁ at 0.5, 1.0, and 2.0 µg/L, respectively, and 0.53 in the naturally contaminated milk. Significant differences were noted in the EFs of the products from the naturally and artificially contaminated milk. This study was the first to demonstrate that EFs obtained from both naturally and artificially contaminated milk in Gouda cheese. Additionally, the EF of butter was examined using only the milk artificially contaminated with AFM₁ at 0.5, 1.0, and 2.0 µg/L. The EFs ranged from 0.12-0.34, indicating that AFM₁ was not enriched in the butter.

Keywords : aflatoxin M₁ (AFM₁), cheese, butter, transfer, enrichment factor (EF)

I Introduction

Aflatoxins, a group of potent carcinogenic and teratogenic compounds, are secondary metabolic products of *Aspergillus flavus*, *A. parasiticus*, and *A. nomius* that grow in various agricultural products. Aflatoxin M₁ (AFM₁), which is an aflatoxin B₁ (AFB₁) metabolite, contaminates mammalian milk¹⁾ through feed. Since AFM₁ is a stable compound, dairy products such as cheese and butter are thought to be contributors of exposure to AFM₁ in humans.

The International Agency for Research on Cancer (IARC) classified aflatoxins including AFM₁ as carcinogenic for humans (Group 1)²⁾. The carcinogenic potential of AFM₁ as determined through experiments is one order of magnitude less than that of AFB₁³⁾. Based on this risk assessment, the Codex Alimentarius Commission established a maximum residual level (MRL) of 0.5 µg/kg for AFM₁ in milk³⁾ in 2001. Many countries have also established their own MRLs. In the United States, for example, the MRL for milk is 0.5 µg/kg⁴⁾, and 0.05 µg/kg in the European Union⁵⁾. In 2016, the