

Estimation of Aflatoxin M1 Exposure through Consumption of Various Dairy Milk Products in Yogyakarta, Indonesia

(ESTIMASI PAPARAN AFLATOKSIN M1 MELALUI KONSUMSI BERBAGAI PRODUK SUSU DI YOGYAKARTA, INDONESIA)

Ika Sumantri^{1*}, Fitri Purwanti², Nuryono³, Ali Agus⁴

¹Department of Animal Science, Faculty of Agriculture,
Lambung Mangkurat University,
Jln Jendral Ahmad Yani, km 36, Banjarbaru,
Kalimantan Selatan, Indonesia, 70714

²Integrated Research and Assesment Laboratory,

³Faculty of Mathematics and Natural Sciences,

⁴Faculty of Animal Science,
Universitas Gadjah Mada, Yogyakarta, Indonesia

*Email: isumantri@ulm.ac.id

ABSTRACT

This study was conducted to investigate the occurrence of aflatoxin M1 (AFM1) in various milk products marketed in Yogyakarta Province (Indonesia) and to estimate the exposure of aflatoxin through contaminated milk consumption. Fresh milk (n=20), pasteurized milk (n=16), and recombined milk products (n=6) were sampled for AFM1 concentration testing by a competitive ELISA test using ELISA kit for AFM1 assay. A survey was conducted to interview consumers (n=88) on milk consumption habit (milk type and amount of consumption). ELISA assays showed 92.5% of samples were contaminated with AFM1 in a range of 24-570 ng/L (average: 216 ng/L). The highest average AFM1 concentration was detected in pasteurized milk sample (244 ng/L), followed by fresh milk (219 ng/L), and the lowest was in recombined milk sample (131 ng/L). However, 100% of recombined milk samples had AFM1 concentration >50-500 ng/L. Thus, recombined milk product was most likely the main source of AFM1 intake due to its high daily consumption in all age groups. Based on AFM1 levels found in milk and consumption of corresponding milk sample, it was estimated that the overall AFM1 exposure ranges from 1.23 ng/kg body weight/day (in 6-15 year-old children) up to 5.26 ng/kg body weight/day (in 3-5 year-old children). In conclusion, this study revealed high occurrences of AFM1 dairy milk marketed in Yogyakarta. Although levels of AFM1 contamination were in Indonesian regulatory limit, high exposure of aflatoxin found in all age groups of consumer. Thus, this preliminary study provides evidence that AFM1 contaminated milk is a serious public health hazard in Indonesia.

Key words: aflatoxin M1; aflatoxin transfer; aflatoxin exposure; dairy milk

ABSTRAK

Penelitian bertujuan untuk mengetahui tingkat kejadian cemaran aflatoksin M1 (AFM1) pada berbagai produk susu sapi perah yang dipasarkan di Kabupaten Sleman dan Kulomprogo serta Kotamadya Yogyakarta, Daerah Istimewa Yogyakarta, Indonesia, serta estimasi paparan AFM1 melalui konsumsi susu terkontaminasi tersebut. Sampling dilakukan pada susu segar (n=20), susu pasteurisasi (n=16) dan susu rekombinasi (n=6) untuk diuji kandungan AFM1-nya dengan metode kompetitif ELISA menggunakan ELISA kit untuk analisis AFM1. Selain itu, wawancara juga dilakukan pada konsumen susu (n=88) untuk mengetahui kebiasaan minum susu (jenis dan jumlah konsumsi). Analisis ELISA memperlihatkan 92,5% dari sampel susu terdeteksi mengandung AFM1 dengan kisaran 24-570 ng/L (rerata 216 ng/L). Konsentrasi AFM1 tertinggi ditemukan pada sampel susu pasteurisasi (244 ng/L), diikuti susu segar (219 ng/L) dan susu rekombinasi (131

ng/L). Meskipun demikian, susu rekombinasi memiliki tingkat kejadian cemaran AFM1 100% dengan tingkat cemaran antara 50-500 ng/L. Berdasarkan data konsentrasi AFM1 sampel susu, konsumsi susu sampel, berat badan dan kelompok umur konsumen, diestimasikan paparan AFM1 melalui susu berkisar dari 1,23 ng/kg bobot badan/hari (kelompok usia 6-15 tahun) hingga 5,26 ng/kg bobot badan/hari (kelompok usia 3-5 tahun). Disimpulkan, bahwa kejadian cemaran AFM1 tinggi pada susu yang dipasarkan di Yogyakarta. Meskipun tingkat cemaran AFM1 masih dalam batas yang diperbolehkan, namun tingkat paparan yang tinggi ditemukan pada semua kelompok umur. Oleh sebab itu, studi awal ini menegaskan bahwa susu yang tercemar aflatoksin merupakan masalah serius dalam kesehatan masyarakat di Indonesia.

Kata-kata kunci: aflatoksin M1; transfer aflatoksin; paparan aflatoksin; susu sapi

INTRODUCTION

Aflatoxin is a secondary metabolite generally produced by toxigenic strains of fungi, *Aspergillus flavus* and *A. parasiticus*. Among the group of mycotoxin, aflatoxin B1 (AFB1) is the most toxic and carcinogenic (IARC, 2002). Temperature and moisture in the tropical climate favor the growth of and aflatoxin production by toxigenic strains of molds. A 3-year survey conducted by Rodrigues and Naehrer (2012) indicated high aflatoxin contamination in feedstuffs and feed on the equatorial region.

Aflatoxin was present in 82% of corn samples collected from South Asia and in 71% of samples collected from South-East Asia. Surveys on aflatoxin contamination in feedstuffs have been conducted in Indonesia and reveal high occurrence and levels of aflatoxin contamination (Pranowo *et al.*, 2013; Sumantri *et al.*, 2017).

In lactating animals, consumption of AFB1-contaminated feed will result in excretion of aflatoxin metabolites into milk, especially aflatoxin M1 (AFM1), which is similar to AFB1 and is classified as a human carcinogen by IARC (Kos *et al.*, 2014). The carry-over of aflatoxin from feed and metabolite transfer into milk are very worrying because milk constitutes the main food of babies and children, the two age groups that are most vulnerable to the negative impacts of aflatoxin exposure (Mohammadi, 2011). Aflatoxin exposure on human will cause teratogenicity, immuno-toxicity, hepatotoxicity, and mortality. In children, aflatoxin exposure can result in impaired growth (Quintana *et al.*, 2012).

Because of this risk, many countries have imposed regular aflatoxin checks of dairy feed to prevent aflatoxin residues entering the food chain (Volkel *et al.*, 2011). Indonesia National Agency of Drug and Food Control (BPOM)

has established the maximum AFM1 concentration in milk, namely 500 ng/L (BPOM, 2009). However, only a few surveys were conducted to investigate aflatoxin contamination in dairy milk products in Indonesia and none assessed on the AFM1 intake.

Expanding of middle class in Indonesia leads to strong growing of dairy milk consumption, which is reported 15% increases (GAIN, 2016). Therefore, current survey was conducted to investigate the presences and levels of AFM1 in dairy milk products marketed in Yogyakarta (Indonesia). Also, to estimate AFM1 intake and describe the consumer risk of aflatoxin exposure through consumption of contaminated milk. Yogyakarta city is important in this study due to dairy milk consumption is significantly influenced by age and education level of the consumer (Widiati *et al.*, 2013). This preliminary study on aflatoxin exposure will provide evidence the potential hazard of aflatoxin contaminated milk on food safety in Indonesia.

RESEARCH METHODS

Milk Samples Collection

The sampling was carried out in Yogyakarta Province, namely in Sleman, Yogyakarta, and Kulon Progo Districts. Milk samples were obtained randomly from dairy cooperatives, milk retailers and milk bar in Yogyakarta, that were classified as fresh milk (n=20) and pasteurized milk (16). As a reference, samples of recombined milk products (n=6) from different brands were analysed for the possibility of AFM1 contamination in commercial milk products. All of milk products were produced in Indonesia. As much as 500 mL pasteurized milk samples were homogenized, and 5 mL samples were poured into 5 mL tubes and stored in the freezer before analysis. Recombined milk samples were collected as follow: a packed of re-