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RESEARCH ARTICLE

Effects of Nutritional Habits on the Presence of Aflatoxin M1 in the Breast Milk

Mine CENGİZ[1,*] Ziya Gökalp CEYLAN[2]

[1] *Faculty of Nursing Department of Public Health Nursing, Atatürk University, Erzurum, Turkiye*
[2] *Faculty of Veterinary Medicine, Department of Food Hygiene and Technology, Ataturk University, Erzurum, Turkiye*

** Corresponding author E-mail: minecengiz25@gmail.com*

HIGHLIGHTS

- The presence of Aflatoxin M1 in the breast milk of feeding mothers in Erzurum was investigated against their nutritional habits.
- The presence of Aflatoxin M1 in breast milk was found to not pose a significant risk.
- Frequent consumption of fresh fruits and vegetables during breastfeeding was found to improve the quality of breast milk.

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ABSTRACT

Investigating the Aflatoxin M1 (AFM_1) presence in the breast milk of the nursing mothers in Erzurum province, depending on their nutritional habits. Study was conducted on the mothers (s=90) who have 0-12 months infants and reside in the province of Erzurum, in accordance with ethical considerations. While collecting the data, a questionnaire was conducted to determine the period of breast feeding, Body Mass Index (BMI) and nutritional habits and the presence of AFM_1 was determined by ELISA method. No correlation has been found between Body Mass Index and mothers' nutritional habits with the AFM_1 concentration in breast milk ($p>0.05$) and AFM_1 concentration varied between 0.0049 – 0.01503 ppm (µg/kg) and determined as 0.006182±0.001748 ppm (µg/kg) on average. A negative correlation has been found with the AFM_1 concentration in breast milk for the mothers who frequently consume fresh fruits and vegetables ($r=-0.235$) ($p<0.05$). While the presence of AFM_1 in breast milk does not pose a significant risk, mothers' frequent consumption of fresh fruits and vegetables during breast feeding period may increase the breast milk quality which has a fundamental importance on the infant development and health.

Contents

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1. Introduction

It has been reported that 25% of the crops are exposed to mold contamination and this contamination causes serious economic damages. Some molds may cause the formation of toxic seconder metabolites, also known as mycotoxins and pose a threat to human health. Mycotoxins are not only in vegetable sources but also can pass into animals who fed with contaminated animal feed and their products such as milk, meat and egg (Carry Over) [1, 2].

Mycotoxins; carcinogenic (aflatoxins, ochratoxins, and fumonisins), mutagenic (aflatoxins, sterigma toxins), teratogenic (ochratoxin), estrogenic (zearalenone), hemorrhagic (trichothecenes), immunotoxic (aflatoxins and ochratoxins), nephrotoxic (ochratoxins), hepatotoxic (aflatoxins and phomopsis), dermatoxic (trichothecenes) and neurotoxic (ergotoxines, penitrems, lolitrems and paxilline) have effects on human health [3, 4]. Aflatoxins are one of the most dangerous mycotoxins due to their high toxic properties [5, 6].

Aflatoxins can be synthesized by *Aspergillus flavus*, *Aspergillus paraciticus*, *Aspergillus nomius* and by some *Emericella* and *Rhizopus* species [7, 8]. Aflatoxin derivatives include 6 main compounds namely, Aflatoxin B_1, B_2, G_1, G_2 and Aflatoxin M_1 (AFM_1) and Aflatoxin M_2 (AFM_2) [2, 9]. AFB_1 is found in the animal feed and in the food which humans consume and they may pass into the human and animal milk as AFM_1 [10]. International Agency for Research on Cancer (IARC) defined the compounds of Aflatok B_1 (AFB_1) as first degree and Aflatoxin M_1 (AFM_1) as second degree carcinogenic [11–13]. Presence of AFM_1 in human and animal milk may pose a serious problem on adult and infant health [10, 14–19]. The diets of infants depend on the mother's diet. Contamination of the food which mothers consume with aflatoxins causes the presence of AFM_1 in breast milk in various proportions [10, 20]. In the conducted studies, it is found that in the case of AFB_1 presence in the food which nursing mothers consume, AFM_1 in the breast milk is detected [10, 14, 15, 17–19, 21–31].

Infants are more susceptible to aflatoxins when compared to adults due to their low body weights, incomplete development of tissues and organs, and underdeveloped detoxification mechanisms [17, 32, 33]. Complete absence of AFM_1 in breast milk is accepted as a base for the growth and development of children. No studies were encountered which were investigating whether there is a relationship between mothers' nutritional habits and AFM_1 In the case of a relationship between the presence of AFM_1 and mothers' nutritional habits, some strategies can be specified for the mother's and infant's nourishment. Although the cultural eating habit of Erzurum which is located in eastern part Turkey is carbohydrate heavy, fresh fruit and vegetable consumption is frequent.

This study aims to investigate the relationship between the presence of AFM_1 in the breast milk of mothers with 0-12 months old infants and their nutritional habits.

H_0: There is no relationship between the frequency of food consumption of nursing mothers and AFM_1 levels.

H_1: There is a relationship between the frequency of food consumption of nursing mothers and AFM_1 levels.

2. Materials and Methods

2.1. Study design and subjects

The research was carried out between February and June 2012 in Erzurum in descriptive type. The universe consists of the mothers with 0-12 months old infants (s=90), who are open to cooperation and agreed on the research. The data of the study were collected in a Family Health Center, and no sample selection was made in the study. After obtaining written consent from mothers who agreed to participate in the study, they were included in the study.

2.2. Research instruments

In the collection of the data, personal information forms which determines the age of the mother, period of breast feeding and the BMI and Nutrient Consumption Frequency forms which determines the frequency of food consumption were utilized [34].

While collecting the data, research and its purpose explained to the mothers and questionnaires were conducted after their written consent and the BMI measurements were taken by the researcher. The questionnaires were conducted on mothers at the breastfeeding room in the health institution, within the appropriate hours they consented, as a face-to-face interview and their milk was collected here as well, under appropriate conditions.

The breast milk was collected in aseptic conditions by using milking method in 10 ml sterile tubes. These samples were brought to the laboratory and the cold chain remained unbroken until the analysis.

2.3. Statistical analysis

The collected data is grouped as a percentage and they also correlated with the Aflatoxin M_1 concentration in the breast milk. To determine the AFM_1 levels in breast milk samples, commercial aflatoxin M_1 ELISA (Ridascreen® Aflatoxin M_1) kit was utilized [35].

In the Food Consumption Frequency form, correlation analysis (p=0.05) was performed using the package program (IBM SPSS 20) to determine the relationship between the frequency of consumption values calculated for each food group and the presence of AFM1 in breast milk. In addition, frequency distributions were calculated according to the consumption frequency of the participating subjects for each food group.

2.4. Variables of the research

The variables considered within the scope of the research are as follows:

Dependent variable(s): AFM_1 level.

Independent variables: BMI level, the frequency of food consumption.

Control variables: Age of the mother, period of breast feeding

3. Findings

The study that examines the presence of AFM_1 , according to the nutritional habits of nursing mothers that live in the province of Erzurum, it was determined that 56.67% of mothers were in the 21-30 age group and 50% in the 1 – 3. months breastfeeding period.

Concentration of AFM_1 in the breast milk varied between 0.0049-0.01503 ppm (µg/kg) and the average was found to be 0.006182 ± 0.001748 ppm (µg/kg).

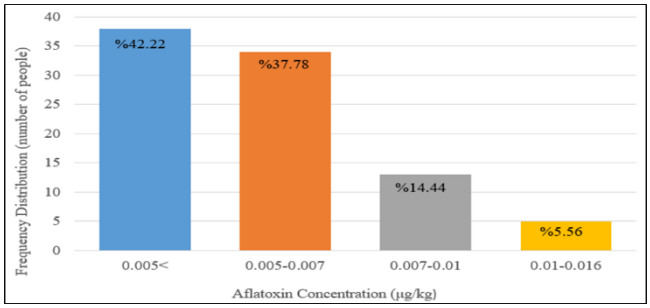

Figure 1 Aflatoxin M_1 rates frequency distribution of the nursing mothers' milk, participating in the study.

In 42.22% of the mothers' milk were found to have an insignificant level of AFM_1 value (AFM_1= 0.005 ppm (µg/kg)) and 5.56% of them to have a significant AFM_1 level, between 0.01-0.016 ppm (µg / kg) (Figure 1).

When the socio-demographic characteristics of mothers are examined; 56.67% were found to be between the ages of 21-30 and 50% were between the nursing period of 1-3 months (Table 1).

Table 1 Age and nursing period of mothers participating in the study

Socio-demographic characteristics	Frekans (N)	Percent (%)
Age (%)		
15-20 age	5	5.56
21-30 age	51	56.67
31-35 age	22	24.44
35 age and over	12	13.33
Breastfeeding period		
0-1 month	16	17.78
1-3 months	45	50.00
3-6 months	10	11.11
6-9 months	9	10.00
9 months and over	10	11.11

The anthropometric measurement values of mothers participating in the study were found to be between 50-98 kg of body weight and the average was calculated to be 68.29 ± 10.72 kg. The minimum value of body length of nursing mothers was 147 cm and the maximum value was 174 cm, average was identified as 1.61 ± 0.61 cm. The minimum BMI index of the mothers was found to be 17.84 kg/m², maximum value was 37.33 kg/m², average was calculated as 26.54 ± 4.02 kg/m² and minimum value with the waist/hip ratio was measured as 0.54 cm, maximum value as 1 cm, with the average of 0.81 ± 0.072 cm (Table 2).

Table 2 Anthropometric measurement results of mothers participating in the study

	$\bar{X}$±S	Minimum	Maximum
Body weight (kg)	68.29±10.72	50.00	98.00
Height (m)	1.61±0.61	1.47	1.74
BMI (formula)	26.54±4.02	17.84	37.33
Waist / Hip (cm / cm)	0.81±0.072	0.54	1.00

$\bar{X}$: Average S: Standard deviation

Furthermore, no statistical correlation was found between the determined AFM_1 concentrations of breast milk and weight, height, BMI values, waist/hip ratio, age, nursing period of mothers ($p>0.05$).

Although no correlation is found between the AFM_1 concentration, found in breast milk and consumption of food groups, other than fresh vegetables and fruits ($p>0.05$), a negative correlation was established with the consumption of fresh vegetables and fruits ($p<0.05$) (Table 3).

Table 3 Correlation between the AFM_1 rates in breast milk and the fresh fruits and vegetable they consume

Content	Correlation Coefficient	Fresh Vegetables and Fruits
AFM_1	r	-0.235*

*:$p<0.05$;

4. Discussion

The study that examines the presence of AFM_1 , according to the nutritional habits of nursing mothers that live in the province of Erzurum, it was determined that concentration of AFM_1 in the breast milk varied between 0.0049-0.01503 ppm (µg/kg) and the average was found to be 0.006182 ± 0.001748 ppm (µg/kg). In none of the breast milk samples, AFM_1 values were found to be above the acceptable value (infant formulas and follow-on formulas; 0.025), according to the Turkish Food Codex [36].

Presence of AFM_1 in the breast milk shows that mothers are exposed to AFB_1 as they consume nutrients and in similar studies [14, 15, 17–19, 26, 30] , it was also shown that infants that feed on breast milk may be exposed to aflatoxin. The AFM_1 concentrations obtained from the study shows similarities with the AFM_1 concentration levels of the breast milk of nursing mothers in İstanbul [25], Afyonkarahisar [17], and Ankara [26]. When research results are evaluated in terms of aflatoxin concentrations in the breast milk worldwide, values determined in Iran [14] were found to be similar with France [31], however studies conducted in Brazil , Sudan [30], Zimbabwe [31], Gambia [29], Australia Victoria Region Thailand [18], Sierra Leone [24], United Arab Emirates [21, 22], Egypt [27, 28], Iran [15] have shown lower concentrations of breast milk AFM_1. It is thought that this difference is due to the fact that countries that this research is conducted in are developing countries, where hygienic standards are generally insufficient.

In the research, no statistical correlation was found between the determined AFM_1 concentrations of breast milk and weight, height, BMI values, waist/hip ratio, age, nursing period of mothers ($p>0.05$). This finding is similar to the results of the study [37], in which the BMI values of nursing mothers are identified. This shows similarities with the study

conducted in Ankara [26], in terms of the relationship between the concentration of AFM_1, that is found in the breast milk and the values of anthropometric measurements.

Although no correlation was found in the study between the AFM_1 concentration, found in breast milk and consumption of food groups, other than fresh vegetables and fruits ($p>0.05$), a negative correlation was established with the consumption of fresh vegetables and fruits ($p<0.05$). Observing a negative correlation between the fresh vegetable and fruit consumption and AFM_1 concentration of breast milk, is thought to be related with the low levels of aflatoxin formation due to mold contamination, which is a result of lack of long term storage of fresh fruits and vegetables.

5. Conclusion

It was determined that AFM_1 concentrations in all breast milk samples, were within acceptable limits according to Turkish Food Codex.

It was determined in the study that fresh vegetable and fruit consumption is a reducing factor for the AFM_1 concentration in breast milk. Increasing the proportion of fresh vegetables and fruits in mothers' diets should be encouraged.

As the possibility of AFM_1 presence is increased in the milk of the mothers, who have consumed nutrients that were contaminated with aflatoxin; it is important to develop a food safety and hygienic standards in this regard and educate mothers.

Ethics Approval and Considerations

Ethics committee approval with 5.1/5 issue number was obtained at 29.11.2012 from Ethics Board of Institute of Health Sciences in Ataturk University before starting the research. To protect the rights of mothers, the reason, the duration and the procedures that will be followed during the research were explained before collecting the data and the principle of "Informed Consent" was complied.

Declaration of Conflict of Interest

Authors declare that they have no conflict of interest with any person, institution, or company.

References

[1] Bryden WL. Mycotoxins in the food chain: human health implications. *Asia Pacific journal of clinical nutrition* (2007) **16 Suppl 1**:95–101.

[2] Tolosa J, Rodríguez-Carrasco Y, Ruiz MJ, Vila-Donat P. Multi-mycotoxin occurrence in feed, metabolism and carry-over to animal-derived food products: A review. *Food and Chemical Toxicology* (2021) **158**:112661. doi:10.1016/j.fct.2021.112661.

[3] Steyn PS. Mycotoxins, general view, chemistry and structure. *Toxicology Letters* (1995) **82-83**:843–851. doi:10.1016/0378-4274(95)03525-7.

[4] Mir SA, Dar BN, Shah MA, Sofi SA, Hamdani AM, Oliveira CA, et al. Application of new technologies in decontamination of mycotoxins in cereal grains: Challenges, and perspectives. *Food and Chemical Toxicology* (2021) **148**:111976. doi:10.1016/j.fct.2021.111976.

[5] Iqbal SZ. Mycotoxins in food, recent development in food analysis and future challenges; a review. *Current Opinion in Food Science* (2021) **42**:237–247. doi:10.1016/j.cofs.2021.07.003.

[6] O' Riordan MJ, Wilkinson MG. A survey of the incidence and level of aflatoxin contamination in a range of imported spice preparations on the Irish retail market. *Food Chemistry* (2008) **107**(4):1429–1435. doi:10.1016/j.foodchem.2007.09.073.

[7] Rodríguez A, Rodríguez M, Luque MI, Martín A, Córdoba JJ. Real-time PCR assays for detection and quantification of aflatoxin-producing molds in foods. *Food Microbiology* (2012) **31**(1):89–99. doi:10.1016/j.fm.2012.02.009.

[8] Ahmed Ismail M, Thabet Abo El-Maali N, Ali Omran G, Masood N. Biodiversity of Mycobiota in Peanut Seeds, Corn and Wheat Grains with Special Reference to Their Aflatoxigenic Ability. *Journal of microbiology, biotechnology and food sciences* (2016) **5**(4):314–319. doi:10.15414/jmbfs.2016.5.4.314-319.

[9] Ismail Y.S. Rustom. Aflatoxin in food and feed: occurrence, legislation and inactivation by physical methods. *Food Chemistry* (1997) **59**(1):57–67.

[10] Galvano F, Pietri A, Bertuzzi T, Gagliardi L, Ciotti S, Luisi S, et al. Maternal dietary habits and mycotoxin occurrence in human mature milk. *Molecular Nutrition and Food Research* (2008) **52**(4):496–501. doi:10.1002/mnfr.200700266.

[11] Pavlek Ž, Bošnir J, Ivešić M, Serdar S, Kuharić Ž, Jakopović Ž, et al. Investigation of milk quality after removal of afm1 using lactic acid bacteria and beta-glucan. *Medica Jadertina* (2021) **51**(1):5–12.

[12] Kırdar S. Mycotoxins in milk and products. In: *Turkey 9th Food Congress* (2002). 24-26 May, Bolu.

[13] International Agency for Research on Cancer. International Agency for Research on Cancer Iarc Monographs on the Evaluation of Carcinogenic Risks To Humans. *Iarc Monographs On The Evaluation Of Carcinogenic Risks To Humansarc Monographs On The Evaluation Of Carcinogenic Risks To Humans* (2002 1) **96**:i-ix+1-390.

[14] Ghiasian S, Maghsood A. Infants' Exposure to Aflatoxin M1 from Mother's Breast Milk in Iran. *Iranian journal of public health* (2012) **41**(3):119–126.

[15] Sadeghi N, Oveisi MR, Jannat B, Hajimahmoodi M, Bonyani H, Jannat F. Incidence of aflatoxin M1 in human breast milk in Tehran, Iran. *Food Control* (2009) **20**(1):75–78. doi:10.1016/j.foodcont.2008.02.005.

[16] Pandey AK, Shakya S, Patyal A, Ali SL, Bhonsle D, Chandrakar C, et al. Detection of aflatoxin M1 in bovine milk from different agro-climatic zones of Chhattisgarh, India, using HPLC-FLD and assessment of human health risks. *Mycotoxin Research* (2021) **37**(3):265–273. doi:10.1007/s12550-021-00437-9.

[17] Özdemir M, Kuyucuoglu N. Afyonkarahisar ilindeki Hastanelerde Doğum Yapan Kadmların Sütlerinde Aflatoksin M1 Düzeylerinin Belirlenmesi [Determination of Aflatoxin M1 Levels in the Milk of Hospitals in Afyonkarahisar Province]. *Kocatepe Medical Journal* (2007) **8**(1). doi:10.18229/ktd.61441.

[18] Navas SA, Sabino M, Rodriguez-Amaya DB. Aflatoxin M 1 and ochratoxin A in a human milk bank in the city of São Paulo, Brazil. *Food additives and contaminants* (2005) **22**(5):457–462. doi:10.1080/02652030500110550.

[19] El-Nezami HS, Nicoletti G, Neal GE, Donohue DC, Ahokas JT. Aflatoxin M1 in human breast milk samples from Victoria, Australia and Thailand. *Food and Chemical Toxicology* (1995) **33**(3):173–179. doi:10.1016/0278-6915(94)00130-G.

[20] Eshete M, Gebremedhin S, Alemayehu FR, Taye M, Boshe B, Stoecker BJ. Aflatoxin contamination of human breast milk and complementary foods in southern Ethiopia. *Maternal & Child Nutrition* (2021) **17**(1). doi:10.1111/mcn.13081.

[21] Saad AM, Abdelgadirt AM, Moss MO. Exposure of infants to aflatoxin M 1 from mothers' breast milk in Abu Dhabi, UAE. *Food additives and contaminants* (1995) **12**(2):255–261. doi:10.1080/02652039509374300.

[22] Abdulrazzaq YM, Osman N, Yousif ZM, Al-Falahi S. Aflatoxin M 1 in breast-milk of UAE women. *Annals of Tropical Paediatrics* (2003) **23**(3):173–179. doi:10.1179/027249303322296484.

[23] Jolly PE, Mazariegos M, Contreras H, Balas N, Junkins A, Aina IO, et al. Aflatoxin Exposure Among Mothers and Their Infants from the Western Highlands of Guatemala. *Maternal and Child Health Journal* (2021) **25**(8):1316–1325. doi:10.1007/s10995-021-03151-1.

[24] Jonsyn FE, Maxwell SM, Hendrickse RG. Ochratoxin A and aflatoxins in breast milk samples from Sierra Leone. *Mycopathologia* (1995) **131**(2):121–126. doi:10.1007/BF01102890.
[25] Keskin Y, Başkaya R, Karslı S, Yurdun T, Özyaral O. Detection of Aflatoxin M1 in Human Breast Milk and Raw Cow's Milk in Istanbul, Turkey. *Journal of Food Protection* (2009) **72**(4):885–889. doi:10.4315/0362-028X-72.4.885.
[26] Barut Uyar B. Anne Sütündeki Aflatoksin M1 ve Okratoksin A Miktarları ile Annenin Beslenme Durumu Arasındaki İlişkinin Değerlendirilmesi [Evaluation of the Relationship Between Aflatoxin M1 and Ochratoxin A Amounts in Breast Milk and Mother's Nutritional Status] (2013).
[27] am El-Sayed Abd Alla, Neamat-Allah AA, Aly SE. Situation of mycotoxins in milk, dairy products and human milk in Egypt. *Mycotoxin Research* (2000) **16**(2):91–100. doi:10.1007/BF02946108.
[28] Polychronaki N, C. Turner P, Mykkänen H, Gong Y, Amra H, Abdel-Wahhab M, et al. Determinants of aflatoxin M 1 in breast milk in a selected group of Egyptian mothers. *Food additives and contaminants* (2006) **23**(7):700–708. doi:10.1080/02652030600627222.
[29] Zarba A, Wild CP, Hall AJ, Montesano R, Hudson GJ, Groopman JD. Aflatoxrn M 1 in human breast milk from The Gambia, West Africa, quantified by combined monoclonal antibody immunoaffinity chromatography and HPLC. *Carcinogenesis* (1992) **13**(5):891–894. doi:10.1093/carcin/13.5.891.
[30] Coulter JBS, Lamplugh SM, Suliman GI, Omer MIA, Hendrickse RG. Aflatoxins in human breast milk. *Annals of Tropical Paediatrics* (1984) **4**(2):61–66. doi:10.1080/02724936.1984.11748311.
[31] Wild CP, Pionneau FA, Montesano R, Mutiro CF, Chetsanga CJ. Aflatoxin detected in human breast milk by immunoassay. *International Journal of Cancer* (1987) **40**(3):328–333. doi:10.1002/ijc.2910400308.
[32] Costamagna D, Gaggiotti M, Signorini ML. Quantitative risk assessment for aflatoxin M1 associated with the consumption of milk and traditional dairy products in Argentina. *Mycotoxin Research* (2021) **37**(4):315–325. doi:10.1007/s12550-021-00444-w.
[33] Galvano F, Galofaro V, Galvano G. Occurrence and Stability of Aflatoxin M1 in Milk and Milk Products: A Worldwide Review. *Journal of Food Protection* (1996) **59**(10):1079–1090. doi:10.4315/0362-028X-59.10.1079.
[34] Pekcan G. Beslenme durumunun saptanması [Determination of nutritional status]. In: Baysal A, editor. *Diyet El Kitabı [Dietary Handbook]*: Ankara: Hatiboğlu (2008). p. 67–141.
[35] Food & Feed Analysis. *RIDASCREEN®FAST Aflatoxin M1: Enzyme immunoassay for the quantitative analysis of Aflatoxin M1 - Art. No.: R5812* (2022) [cited 2022 Jul 22]. Available from: https://food.r-biopharm.com/products/ridascreenfast-aflatoxin-m1-2/.
[36] Communique TGK. *Turkish food codex communiqué on determination of maximum levels of specific contaminants in foodstuffs* (2011). 28257 p.
[37] Aydın M. Investigating relationship between nutritional status and leptin and ghrelin levels of maternal serum and breast milk. *Hacettepe University Institute of Health Sciences Master's Thesis in Dietetic Program, Ankara* (2013).