Central Asian Journal of Veterinary Science – Astana: S. Seifullin Kazakh Agrotechnical Research University, 2026. – № 1 (013). – P.31-40.- ISSN 3135-2413, 3135-2421

doi.org/10.51452/cajvs.2026.1(013).2150
UDC 619:614.31:631.576.2(574) (045) **Research article**

Sanitary assessment of nuts in the markets of the Republic of Kazakhstan

Laura T. Auteleyeva[1], Balgabay S. Maikanov[1], Aigul Sh. Sharipbayeva[2]
Ayana S. Smagulova[3], Zhazira Zh. Yermuhametova[4]

[1]S. Seifullin Kazakh Agrotechnical Research University, Astana, Kazakhstan
[2]Kazakh Academy of Nutrition, Almaty Kazakhstan
[3]L.N. Gumilyov Eurasian National University, Astana, Kazakhstan
[4]National Accreditation Center of the Republic of Kazakhstan, Astana, Kazakhstan

Corresponding author: Laura T. Auteleyeva: l.auteleeva@kazatu.edu.kz
Co-authors: (1: MB) b.maykanov@kazatu.edu.kz; (2: ShA) aigul-69.69@mail.ru
(3: SA) smagulovaayana28@gmail.com; (4: YZh) z.ermuhametova@nca.kz
Received: 12 February 2026 **Accepted:** 18 March 2026 **Published:** 30 March 2026

Abstract

Background and Aim. Nuts are a vital component of the human diet; however, they are highly susceptible to contamination by mycotoxins. This study aimed to conduct a comprehensive sanitary assessment of various domestic and imported nuts sold in Kazakhstan's markets, specifically focusing on the quantification of Aflatoxin B1 (AFB1) to evaluate potential carcinogenic risks to consumers.

Materials and Methods. Samples of walnuts, peanuts, almonds, hazelnuts, and pistachios were collected from major wholesale and retail markets in Almaty, Taraz, Shymkent, Astana, and the Turkestan and Kyzylorda regions. The assessment employed a multidisciplinary approach, including organoleptic, physicochemical, and instrumental analyses (High-Performance Liquid Chromatography (HPLC) and Enzyme-Linked Immunosorbent Assay (ELISA) to detect and quantify AFB1 contamination.

Results. Aflatoxin B1 was detected in all analyzed samples. The highest contamination levels were identified in samples from Shymkent, ranging from 0,039 to 0,045 mg/kg. These concentrations significantly exceed the maximum permissible limit (MPL) of 0,005 mg/kg established by the Customs Union and European Union food safety regulations.

Conclusion. The findings indicate that current levels of AFB1 contamination in nuts sold in Kazakhstan pose a notable public health concern. The results highlight the urgent need for systematic monitoring of mycotoxins and the implementation of more robust national food safety control protocols to ensure consumer protection.

Keywords: quality; safety; contamination; aflatoxin; nut.

Introduction

Aflatoxins are among the most potent mutagenic and carcinogenic substances known (JECFA, 1999), affecting all vertebrates, including humans. According to the Food and Agriculture Organization of the United Nations, mycotoxins contaminate a quarter of the world's harvest [1, 2, 3].

Four mycotoxins are commonly found in plant products: aflatoxins B1, B2, G1, and G2 (JECFA, 2002). *Aspergillus, Fusarium,* and *Penicillium* are the three main fungal genera that produce these compounds [4]. Aflatoxins are highly toxic and contaminate a wide range of food products, including corn, peanuts, dried fruits, and meat- and milk-based products [5, 6]. Aflatoxin-producing Aspergillus species include A. flavus, A. nomius, A. parasiticus, and A. astellatus [7].

Mycotoxins are resistant to technological processes, such as cooking, frying, baking, distillation, and fermentation. These fungal secondary metabolites contaminate products of both animal products (beef, pork, poultry, lamb, fish, game meat, and milk) and plant products (cereals, processed cereals, vegetables, and nuts) origin. They can damage crops and cause various mycotoxicoses. The presence of mold in food increases the impact of mycotoxins on humans and animals. AFB1 is widely found in food and is considered a public health problem worldwide because of its carcinogenicity. Therefore, AFB1 concentrations should be monitored [8].

The World Health Organization classifies aflatoxins as teratogenic, mutagenic, carcinogenic, and invisible poisons. Contamination can occur at any stage of food production, from harvest to storage. Of all the mycotoxins affecting food and feed, aflatoxin B1 (AFB1) causes the most harm to human and animal health [9].

Temperature interacts with water activity to affect the regulatory gene ratio, which is directly proportional to AFB1 production. In particular, this interaction affects AFB1 production by *Aspergillus flavus* [10].

This study aimed to provide a scientific sanitary assessment of various nuts sold in Kazakhstan's markets. The following tasks were performed: 1) monitoring the production of domestic and imported nuts; 2) evaluating the quality and safety of various nut samples.

Materials and Methods

A total of 440 samples were collected, comprising 155 domestic and 285 imported products. Nut samples were collected from large markets in Almaty (Sayakhat, Optovka, and Altyn Orda), Taraz (Auyl Bereke), and Shymkent (Aina and Kyrgy). In the Turkestan region, samples were collected from the following locations: the Kalen farm, Sarapkhana rural district, Turbat rural district, Baidibek Ata farm, and Akqum rural district. The Qakpak rural district included the Tegen, Tazabek, Aldan, and Dauey Ata farms. In the Tülkibas district, Zhambyl village, Zhambyl LLP, and the Sansyzbay farm were included. In the Saryagash district, the sampling sites included Silk Alley Winery LLP, Saryagash Zher Syy farm, Saryagash Zher Syy LLP, and the Eski Bazaar market in Kyzylorda. Additionally, in Astana, samples were collected from Artem, Asem, Alem, Eurasia, Shapagat, and the major supplier Sarvinos-S LLP.

The organoleptic examination of the nuts assessed their appearance, shell color, size, surface texture, color, quality, taste, and aroma. The physicochemical assessment included the percentage of nuts damaged by pests, the percentage of underdeveloped and broken nuts, the presence of live pests and their larvae, and the moisture content. The following technical specifications were applied: walnuts GOST 32874-2014); unshelled pistachios GOST 31788-2012; peanuts GOST 31784-2012; cashew kernels GOST 31855-2012; almond kernels GOST 32857-2014. The mass fraction of moisture was determined by sequential drying at 130 ± 2 °C for 40 min in a drying oven [11, 12, 13, 14, 15].

The aflatoxin B1 (AFB1) content of the nuts was quantified using high-performance liquid chromatography in accordance with GOST 30711-2001 [16]. The HPLC equipment was from Waters Corporation (USA) in the accredited laboratory of LLP "Nutritest" of Kazakh Academy of Nutrition (Almaty, Kazakhstan). Immunoenzymatic analysis was performed using a RIDA ABSORBANCE 96 microplate spectrophotometer and RIDASOFT® Win.NET software (Germany). Safety measures were observed when working with methanol (certificate numbers AC 568/1, AC 568/2, and AC 567/1). Calibration was performed using ready-to-use standard solutions included in the kit: 0, 1, 5, 10, 20 and 50 μg/l.

To control method specificity, control samples of nuts free from aflatoxin B1 were used and analyzed in each assay batch (n=3-4 per batch). The optical density of control groups corresponded to the zero standard (0 μg/l), confirming the absence of non-specific binding and adequacy of sample preparation.

Results and Discussion

Several large nut farms operate in the Almaty region. For instance, Integration-Turgen LLP, located in the Enbekshikazakh district, covers 20 ha. This farm grows hazelnuts, which are exported to Italy for use in Nutella products. The trees are young (2-3 years old) and yield up to 10-15 kg per tree. The farm also sells walnut seedlings and is working on cultivating an Italian hazelnut variety, which is larger and has light red skin. Manshuk Farm recently began production on 40 ha. Many nut farms in Kazakhstan have been unproductive in recent years because of spring frosts and the lack of subsidies from the Kazakhstani Ministry of Agriculture. Thus, we obtained nut samples from large markets in Almaty

(Sayakhat, Optovka and Altyn Orda) which sell mainly imported nuts and nuts grown in the Turkestan region (shelled and unshelled walnuts, shelled and unshelled peanuts, and almonds).

The organoleptic characteristics of the nuts sampled from the Almaty and Zhambyl regions met the requirements for fresh nuts, except for the white coating on the shell walnuts from Taraz. No shell defects, broken nuts, mechanical damage or mold were detected in the nut samples from the Almay and Zhambyl regions. The number of dry or underdeveloped kernels was within the permitted limit (2% for walnuts). The presence of dust and dry pericarp was minimal and did not exceed the permissible limits. No live pests were found.

All nut batches met the organoleptic quality indicators corresponding to the premium and first grades; these indicators were the appearance, shell quality, nut size by maximum transverse diameter, nut surface, kernel yield, kernel separability from the shell kernel color and quality, kernel taste and smell, presence of foreign impurities, nut shells, kernel moisture content, presence of nuts with dried skin, presence of nuts damaged by pests, rancid nuts, underdeveloped nuts and presence of live pests (insects or their larvae) inside the nut. Nut plantations in the Zhambyl region are mainly of a small scale and located in private households. Most of the nut harvest from these plantations is for personal use, with the surplus being sold at the Auyl Bereke market in Taraz.

The concentration of AFB1in nuts from the Almaty region ranged from 0,0017 ± 0,001 to 0,0038 ± 0,0034 mg/kg and did not exceed the maximum residue concentration (MRL) (Table 1). However, excessive concentrations of AFB1 were found in some walnut samples sold in markets in Taraz (Zhambyl region). Concentrations in other samples ranged from 0,001 ± 0,00012 to 0,0003 ± 0,0013 mg/kg.

Table 1. The average concentration of aflatoxin B1 in nuts from different regions of Kazakhstan (MRL 0.005 mg/kg)

Number of samples	Type of nuts	Place of sampling, city	The average concentration
5	Walnuts in shell	Shymkent Market ‘Aina’	0,045 ± 0,0004
5	Hazelnuts	Shymkent Market ‘Aina’	0,002 ± 0,0002
4	Walnuts in shell	Lengir	0,006 ± 0,0002
5	Walnuts in shell	Tulkibas	0,013 ± 0,0018
5	Walnuts in shell	Sairam	0,0158 ± 0,0018
4	Walnuts in shell	«Saryagash Zher syy»	0,001 ± 0,0018
7	Almonds	Sairam	0,001 ± 0,0001
7	Hazelnuts	Sairam	0,002 ± 0,0001
4	Walnuts in shell	«Baidibek ata»	0,002 ± 0,0014
7	Almonds	Lengir	0,001 ± 0,0001
7	Hazelnuts	Lengir	0,002 ± 0,0002
7	Walnuts in shell	Kyzylorda	0,012 ± 0,0001
7	Walnuts in shell	Shymkent	0,039 ± 0,003
7	Peanuts	Shymkent	0,002 ± 0,0001
5	Walnuts in shell	Sairam	0,01581 ± 0,0013
4	Walnuts in shell	Tülkibas	0,0247 ± 0,0002
4	Walnuts in shell	Lengir	0,004 ± 0,0012
11	Peanuts	Turkestan	0,045 ± 0,00045
7	Peanuts	Kyzylorda	0,001 ± 0,0041
5	Walnuts in shell	Taraz	0,001±0,00012
5	Walnuts	Taraz	0,02714±0,0027
4	Walnuts in shell	Taraz	0,0003±0,0013
7	Walnut	Taraz	0,0145±0,046

Continuation of Table 1

5	Walnut in shell	Almaty	0,0038±0,0034
7	Almond	Almaty	0,0017±0,001
4	Walnuts in shell	Taraz	0,001±0,00012
6	Walnut	Taraz	0,02714±0,0027

The Turkestan region has favorable conditions for nut cultivation. Nuts are mainly produced by private farms. The largest nut farms in the region are located in the Kazygurst district: the Kalen peasant farm in the Sarapkhana rural district (6 ha) and the Baidibek Ata peasant farm in the Turbat rural district (2 ha), which has 100 nut trees (almonds and walnuts). Approximately 3 t of nuts are harvested annually. These are sourced from Lengir, Saryagash, Zher syiy, Silk alley Winery LLP (Saryagash district), JSC ‘Zhambyl’, the Sansyzbay farm (Tülkibas district), Kalen farm, Sarybekovtar farm, Baidibek Ata farm (Sarapkhana rural district), Tazabek farm, Aldan farm, Dauey Ata farm (Qakpak village), Integration LLP (Turgen, Tülkibas, Sairam and Zhanatalap districts) and Kyrgy and Aina markets (Figure 1).

Figure 1. Walnut tree at the «Baidibek Ata»

There are several peasant farms in the rural district of Qakpak: Tegen (2.73 ha), Tazabek (2 ha), Aldan (3 ha) and Dauey Ata (2.6 ha). The Zhambyl agricultural enterprise of Zhambyl LLP (30 ha) and the Sansyzbay farm (6 ha) are located in the Tülkibas district.

Silk Alley Winery LLP (60 ha) and the Saryagash Zher Siyy peasant farm (100 ha) are located in the Saryagash district (see Table 2). Almonds, hazelnuts, walnuts (280 bushes) and pistachios are grown there. The entire harvest of Saryagash Zher Syy LLP is sold in the Turkestan and Zhambyl regions and exported to Kyrgyzstan (Figures 2 and 3).

Figure 2. Hazelnut seedlings Saryagash Zher Syy LLP

Figure 3. Almond tree Silk Alley Winery ZHS

Table 2. Nut farming enterprises in the Turkestan region

Name	Location	Area, hectares	Type
Saryagash District			
«Saryagash Zher Syy»	Saryagash District, Zhemisti Village	100	almonds, hazelnuts, walnuts, pistachios
«Silk Alley Winery» ZhShS	Kurkeles rural district, Enkes village	60,0	walnuts, almonds, hazelnuts, pistachios
Tülkibas District			
«Zhambyl» ZhS	Zhambyl rural district	30,0	walnuts
«Sansyzbay»	Zhambyl Rural District	6,0	walnuts
Kazygurt District			

Continuation of Table 2

«Kalen»	Saraphana Village	6	walnuts
Turbat rural district			
Sarybekovtar	Ondiris, s.Akkum		walnuts, almonds
«Baidibek ata»	Ondiris, s.Enbek	2	walnuts, almonds
Rural district Kapkapak			
«Tazabek» p/s	Kakpak Village	2	walnuts
«Aldan»	Kakpak Village	3	walnuts
«Dauei ata»	Kakpak Village	2,6	walnuts

The moisture content of the nuts from the two regions studied averaged between 6,08% ± 0,001 and 8,2% ± 0,003.

Analysis of import data revealed that China was the largest source of nut imports between 2021 and 2024, accounting for 58,294.6 t (74.6% of the total volume of imports). The main types of imported nuts were walnuts (43,482.3 t), almonds (11,688 t), macadamia nuts (1,596 t), cashew (344.5 t), pistachios (119.7 t), chestnuts (0,2 t), and pecans (1,063.9 t) (Figure 4).

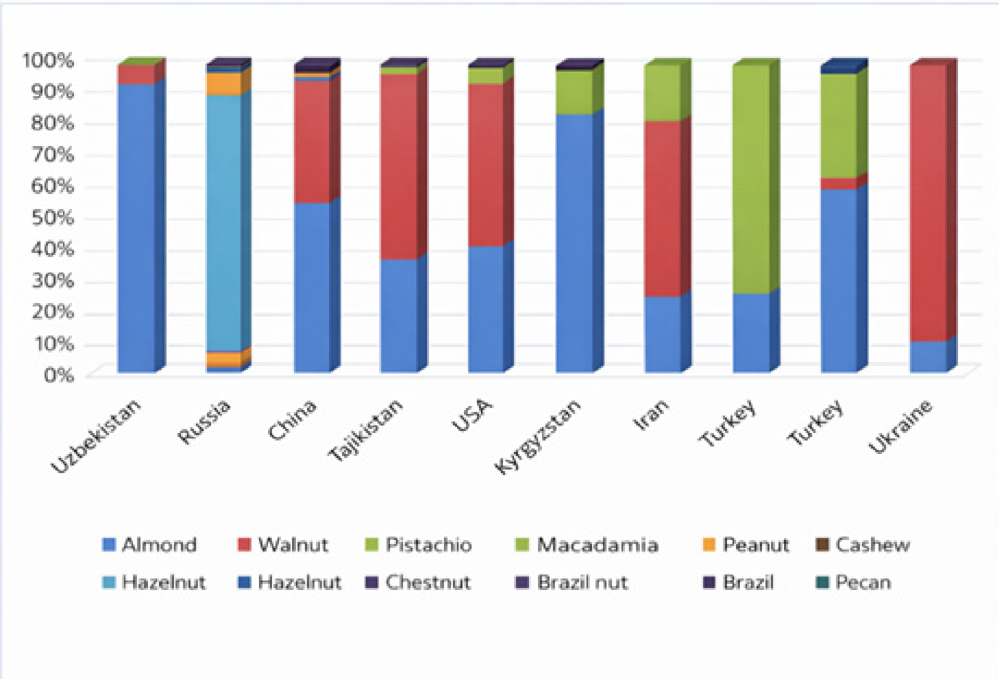

Figure 4. Imports of various nuts to the Republic of Kazakhstan, 2021-2022

The volume of nut imports from the United States was 15,702.9 t (13,712 t of almonds, 1,985.3 t of pistachios, and 4,9 t of pecans), while 2,126.2 t were imported from Russia (1,693.8 t of peanuts).

According to official statistics, the main nut importers are Kyrgyzstan (125.8 t, including 1.3 t of almonds and 5 t of walnuts) and Russia (64.5 t). However, our monitoring data differs from these figures.

From January to July 2023, the largest volume of cashews (1,561.7 t) came from Vietnam (1,427.8 t, or 91,5%), while the largest volume of almonds (10,370 t) came from the United States (60%). China was the leading exporter of walnuts (91,36%, 6,966 t) and pistachios (2,647.6 t).

Uzbekistan is one of the world's leading importers of walnuts (741,9 t) and almonds (274.9 t). Iran is a major importer of pistachios (4,858 t), followed by Turkey (1,137.8 t), which imported 594.8 t of almonds and 454.1 t pistachios in 2023. Other major importers include Tajikistan (953.9 t), Ukraine (438.2 t) and Kyrgyzstan (342.3 t).

It was revealed that out of the 53 nut samples from China, 35.8% exceeded the maximum permissible level of AFB1. Furthermore, walnuts, peanuts, and almonds exceeded the permissible values for total aflatoxins, with concentrations ranging from 0,0014 to 0,6 mg/kg (Table 3).

Table 3. Contamination of imported nuts with aflatoxin AFB1

Country	Number of samples	Positive	%, positive samples	Average AFB1 concentration
China	53	19	35,8	0,004 mg/kg
Uzbekistan	43	11	25,5	0,009 mg/kg
Iran	45	8	17	0,01 mg/kg
Russia	24	5	20,8	0,01 mg/kg
Turkey	16	4	25	0,02 mg/kg
India	21	4	19	0,015 mg/kg
Vietnam	17	3	17,6	0,006 mg/kg

Of the 43 nut samples from Uzbekistan, 25,5% exceeded the maximum permissible level of AFB1. Furthermore, peanuts (0-0.6 mg/kg), walnuts (0-0,55 mg/kg), pistachios (0-0,07 mg/kg), hazelnuts (0-0,26 mg/kg), and almonds (0-0,045 mg.kg) exceeded the permissible values for total aflatoxins. The average concentration was 0,009 mg/kg.

The average maximum concentration of AFB1 in nuts from Russia was 0,01 mg/kg, detected in pecans and walnuts (0-0,009 mg/kg) and hazelnuts (0-0,045 mg/kg). Of the 16 samples imported from Turkey and analyzed for AFB1, 25% exceeded the limit (walnuts, 0-0,003 mg/kg; pistachios, 0-0,045 mg/kg). The average concentration of AFB1 in nut samples from India was 0,015 mg/kg (19%). Among nut samples from Vietnam, three out of 17 (17,6%) exceeded the maximum permissible level of the mycotoxin.

According to organoleptic indicators, all imported nuts were classified as premium and first grade. However, some exceptions were noted: dry, underdeveloped, or damaged shelled walnuts (8,00%) and moldy (1,00%) samples from China; kernels with mechanical damage (20,00%); moldy samples (2,00%); several shelled walnut samples from Chile (20,00%); dry, underdeveloped and damaged hazelnut kernels from Russia (8,00%); shelled walnuts and almonds from Uzbekistan (10,00%)

The domestic nut market mainly comprises imports, which account for more than 70% of the total volume. Large-scale nut cultivation in Kazakhstan began only in 2016-2017, so there is still a lack of experience, specialists, and domestic scientific developments in this area. However, domestic production remains insufficient to meet market demand, leading to continued walnut imports from China, the world's largest producer.

Overall, the results demonstrate that aflatoxin contamination in nuts sold on the domestic and international markets exceeded the maximum permissible levels. Therefore, food safety regulatory authorities should take immediate measures to address this issue, which has serious health implications.

Sampling nuts in markets and reviewing the documents of a major supplier, Sarvinoz-S LLP, revealed that nuts produced in China (almonds, walnuts, cashews, and peanuts), Vietnam (shelled cashew and peanuts), India (peanuts), Azerbaijan (hazelnuts), and Brazil (peanuts) exceeded the maximum permissible levels of aflatoxins.

A quarantine phytosanitary control certificate is issued when units are imported in accordance with the quarantine rules for protecting the territory of the Republic of Kazakhstan. To grant this certificate, samples for analysis and examination (storage pests) are taken by state plant quarantine inspectors. Unfortunately, there is inadequate control and verification of quality compliance certificates.

The research illustrates that nuts imported from various countries (China, Iran, and Turkey, among others) exceed the aflatoxin limits for imports into the European Union (EU). The EU has one of the highest food safety standards in the world, largely due to its robust legislation, ensuring the safety of the food and feed sold there. On the other hand, the food safety standards in Kazakhstan and the CIS countries need to be harmonized with the Codex alimentarius because only then will it be possible to assess the safety of the nuts consumed in the region. Aflatoxin contamination has often caused concern in international trade, as evidenced by notifications published by the EU (RASFF Annual report, 2016) on peanuts exceeding the maximum permissible level of AFB1. Given the increased awareness of the serious health risks associated with aflatoxins, the EU has established strict rules according to which products sold for human consumption cannot exceed 2 and 4 μg/kg of AFB1 and total aflatoxin, respectively (EC 1881/2006). Codex Alimentarius has set a maximum residue limit (MRL) for AFB1 at 15 μg/kg (CODEX STAN 193-1995), while the Food Safety Standards Authority of India has set it at 10 μg/kg for ready-to-eat nuts, 0,004 mg/kg according to EU Commission Regulation No. 1881-2006, and 15 μg/kg for nuts for further processing.

According to data from the Rapid Alert System for Food and Feed (RASFF), most notifications in the EU regarding agricultural products that do not meet requirements, followed by a prevention of entry into the domestic market or withdrawal, concern nuts. Nuts and nut products have consistently been ranked first in this rating over the past four years. The main reasons for non-compliance are pesticides (47,7%), mycotoxins (35,0%), and pathogenic microorganisms (9,6%). Aflatoxins in nuts are the most common cause for concern reported by countries such as Turkey, China, the United States, Argentina, Egypt, and Iran.

Conclusion

This study provides the first comprehensive assessment of mycotoxin contamination in nuts commercialized in Kazakhstan. Three key findings emerge from the analysis. First, despite favourable organoleptic characteristics classifying all Kazakh walnut samples as top grade according to GOST standards, AFB1 contamination was detected across all regional sampling sites. Second, contamination levels in walnuts from Shymkent (0,039-0,045 mg/kg) substantially exceeded the MPL of 0,005 mg/kg established by the Customs Union and EU regulations, posing potential food safety risks. Third, Kazakh walnuts demonstrated lower AFB1 levels compared to imported nuts from China, Uzbekistan, and Russia, where 17,6-35,8% of samples violated safety standards.

The findings carry significant implications for public health and trade regulation. The discrepancy between organoleptic quality and mycotoxin content highlights the inadequacy of visual inspection alone for food safety assurance in nut production and import control. The pronounced geographic variation within the Turkestan region suggests localized factors – possibly pre-harvest conditions, drying practices, or storage parameters – warranting targeted intervention.

Practical recommendations:

1. Test imported nuts, issue certificates of conformity, and develop a national online database modeled after RASFF to identify non-compliant nut importers.
2. Eliminate the fragmented approach to nut safety.
3. Conduct mandatory moisture content analysis of imported nuts at Veterinary and Sanitary Examination laboratories in the markets in Astana.
4. Maintain regulated temperature controls and prevent high humidity during storage and commercial distribution.

Authors' Contributions

LA, BM, ASh and AS: participated in the collection of domestic and imported nut samples in various regions of Kazakhstan and conducted the organoleptic analysis; LA, AS and ZhY: performed the physicochemical characterization to determine the quality and moisture content of the products in accordance with regulations; LA, ASh and AS: determined the content of aflatoxin B1 using HPLC and ELISA.

LA, BM, ASh, AS and ZhY: monitored the market, performed statistical data processing, and prepared a literature review and the final draft of the article; LA, BM, ASh, AS and ZhY: conducted the final revision and proofreading of the manuscript. All authors read, reviewed, and approved the final version of the article.

Acknowledgements

This study was carried out under the framework of the budget program 217, "Development of Science," sub-program 102 "Grant Financing of Scientific Research" for the period 2021-2023. The research was conducted as a part of a project led by young scientists on the topic 5-21/MU23, entitled "Aflatoxin contamination of various nuts and the development of methods for their detoxification".

References

1 Chulze, S.N., Palazzini, J.M., Torres, A.M., Barros, G., Ponsone, M.L., Geisen, R., Köhl, J. (2015). Biological control as a strategy to reduce the impact of mycotoxins in peanuts, grapes and cereals in Argentina. *Food Additives & Contaminants: Part A*, 32(4), 471-479. DOI: 10.1080/19440049.2014.984245.

2 Baiguini, A., Colletta, S., Rebella, V. (2011). Materials and articles intended to come into contact with food: evaluation of the rapid alert system for food and feed (RASFF) 2008-2010. *Igiene e Sanità Pubblica*, 67(3), 293-305.

3 Codex Alimentarius Commission. (1999). Report of the thirtieth session of the Codex Committee on Food Additives and Contaminants (ALINORM 99/12). Joint FAO/WHO Food Standards Programme. https://share.google/fOvEZ2M0uLRkF2Ndn

4 Ebrahimi, A., Emadi, A., Arabameri, M., Jayedi, A., Abdolshahi, A., Yancheshmeh, B.S., Shariatifar, N. (2022). The prevalence of aflatoxins in different nut samples: A global systematic review and probabilistic risk assessment. *AIMS Agriculture & Food*, 7(1). DOI: 10.3934/agrfood.2022009.

5 Бурова, Т.Е. (2020). Б*езопасность продовольственного сырья и продуктов питания.* СПБ.: Лань, 89-90.

6 Magan, N., Olsen, M. (Eds.). (2004). *Mycotoxins in food: detection and control.* NW: Woodhead Publishing, 174-189.

7 Chandra, P. (2021). Aflatoxins: Food safety, human health hazards and their prevention. In Aflatoxins-Occurrence, Detoxification, Determination and Health Risks. *IntechOpen*, 1-11. DOI: 10.5772/intechopen.96647.

8 Kumar, P., Mahato, D.K., Kamle, M., Mohanta, T.K., Kang, S.G. (2017). Aflatoxins: A global concern for food safety, human health and their management. *Frontiers in microbiology*, 7, 235289. DOI: 10.3389/fmicb.2016.02170.

9 Межгосударственный стандарт. ГОСТ 32874-2014 - Орехи грецкие. Технические условия. (2015). Москва: Стандартинформ.

10 Межгосударственный стандарт. ГОСТ 31788-2012 - Орехи фисташковые неочищенные. Технические условия. (2014). Москва: Стандартинформ.

11 Межгосударственный стандарт. ГОСТ 31784-2012 - Арахис. Технические условия. (2012). Москва: Стандартинформ.

12 Межгосударственный стандарт. ГОСТ 31855-2012 - Орехи кешью. Технические условия. (2012). Москва: Стандартинформ.

13 Межгосударственный стандарт. ГОСТ 32857-2014 - Ядра орехов миндаля сладкого. Технические условия. (2014). Москва: Стандартинформ.

14 Межгосударственный стандарт. ГОСТ 30711-2001 - Продукты пищевые. Методы выявления и определения содержания афлатоксинов В1 и М1. (2001). Москва: Стандартинформ.

15 Приказ Министра сельского хозяйства Республики Казахстан от 29 июня 2015 года № 15-08/590 «Об утверждении правил по охране территории Республики Казахстан от карантинных объектов и чужеродных видов». https://adilet.zan.kz/rus/docs/V1500012032.

16 Инвестиционный департамент ФАО. (2019). *Мировые тенденции орехового бизнеса.* https://east-fruit.com/wp-content/uploads/2020/08/mirovye-tendentsii-orekhovogo-biznesa.-rol-mesto-i-perspektivy-tadzhikistana.pdf

References

1 Chulze, S.N., Palazzini, J.M., Torres, A.M., Barros, G., Ponsone, M.L., Geisen, R., Köhl, J. (2015). Biological control as a strategy to reduce the impact of mycotoxins in peanuts,

grapes and cereals in Argentina. *Food Additives & Contaminants: Part A*, 32(4), 471-479. DOI: 10.1080/19440049.2014.984245.

2 Baiguini, A., Colletta, S., Rebella, V. (2011). Materials and articles intended to come into contact with food: evaluation of the rapid alert system for food and feed (RASFF) 2008-2010. *PubMed,* 67(3), 293-305.

3 Codex Alimentarius Commission. (1999). Report of the thirtieth session of the Codex Committee on Food Additives and Contaminants (ALINORM 99/12). J*oint FAO/WHO Food Standards Programme*. https://share.google/fOvEZ2M0uLRkF2Ndn.

4 Ebrahimi, A., Emadi, A., Arabameri, M., Jayedi, A., Abdolshahi, A., Yancheshmeh, B.S., Shariatifar, N. (2022). The prevalence of aflatoxins in different nut samples: A global systematic review and probabilistic risk assessment. *AIMS Agriculture & Food*, 7(1). DOI: 10.3934/agrfood.2022009.

5 Burova, T.E. (2020). *Bezopasnost' prodovol'stvennogo syr'ya i produktov pitaniya*. SPb.: Lan', 89-90. [*in Russ*].

6 Magan, N., Olsen, M. (Eds.). (2004). *Mycotoxins in food: detection and control*. NW: Woodhead Publishing, 174-189.

7 Chandra, P. (2021). Aflatoxins: Food safety, human health hazards and their prevention. In Aflatoxins-Occurrence, Detoxification, Determination and Health Risks. *IntechOpen*, 1-11. DOI: 10.5772/intechopen.96647.

8 Kumar, P., Mahato, D.K., Kamle, M., Mohanta, T.K., Kang, S.G. (2017). Aflatoxins: A global concern for food safety, human health and their management. *Frontiers in microbiology,* 7, 235289. DOI: 10.3389/fmicb.2016.02170.

9 Mezhgosudarstvennyi standart. GOST 32874-2014 - Orehi greckie. Tehnicheskie usloviya. (2015). Moskva: Standartinform. [*in Russ*].

10 Mezhgosudarstvennyi standart. GOST 31788-2012 - Orehi fistashkovye neochishhennye. Tehnicheskie usloviya. (2012). Moskva: Standartinform. [*in Russ*].

11 Mezhgosudarstvennyi standart. GOST 31784-2012 - Arahis. Tehnicheskie usloviya. (2012). Moskva: Standartinform. [*in Russ*].

12 Mezhgosudarstvennyi standart. GOST 31855-2012 - Orehi kesh'yu. Tehnicheskie usloviya. (2012). Moskva: Standartinform. [*in Russ*].

13 Mezhgosudarstvennyi standart. GOST 32857-2014 - Yadra orehov mindalya sladkogo. Tehnicheskie usloviya. (2014). Moskva: Standartinform. [*in Russ*].

14 Mezhgosudarstvennyi standart. GOST 30711-2001 - Produkty pishhevye. Metody vyjavleniya i opredeleniya soderzhaniya aflatoksinov V1 i M1. (2001). Moskva: Standartinform. [*in Russ*].

15 Prikaz Ministra sel'skogo hozyaistva Respubliki Kazahstan ot 29 iyunya 2015 goda № 15-08/590 «Ob utverzhdenii pravil po ohrane territorii Respubliki Kazahstan ot karantinnyh obektov i chuzherodnyh vidov». https://adilet.zan.kz/rus/docs/V1500012032. [*in Russ*].

16 Investicionnyi departament FAO. (2019). *Mirovye tendencii orehovogo biznesa*. https://east-fruit.com/wp-content/uploads/2020/08/mirovye-tendentsii-orekhovogo-biznesa.-rol-mesto-i-perspektivy-tadzhikistana.pdf [*in Russ*].