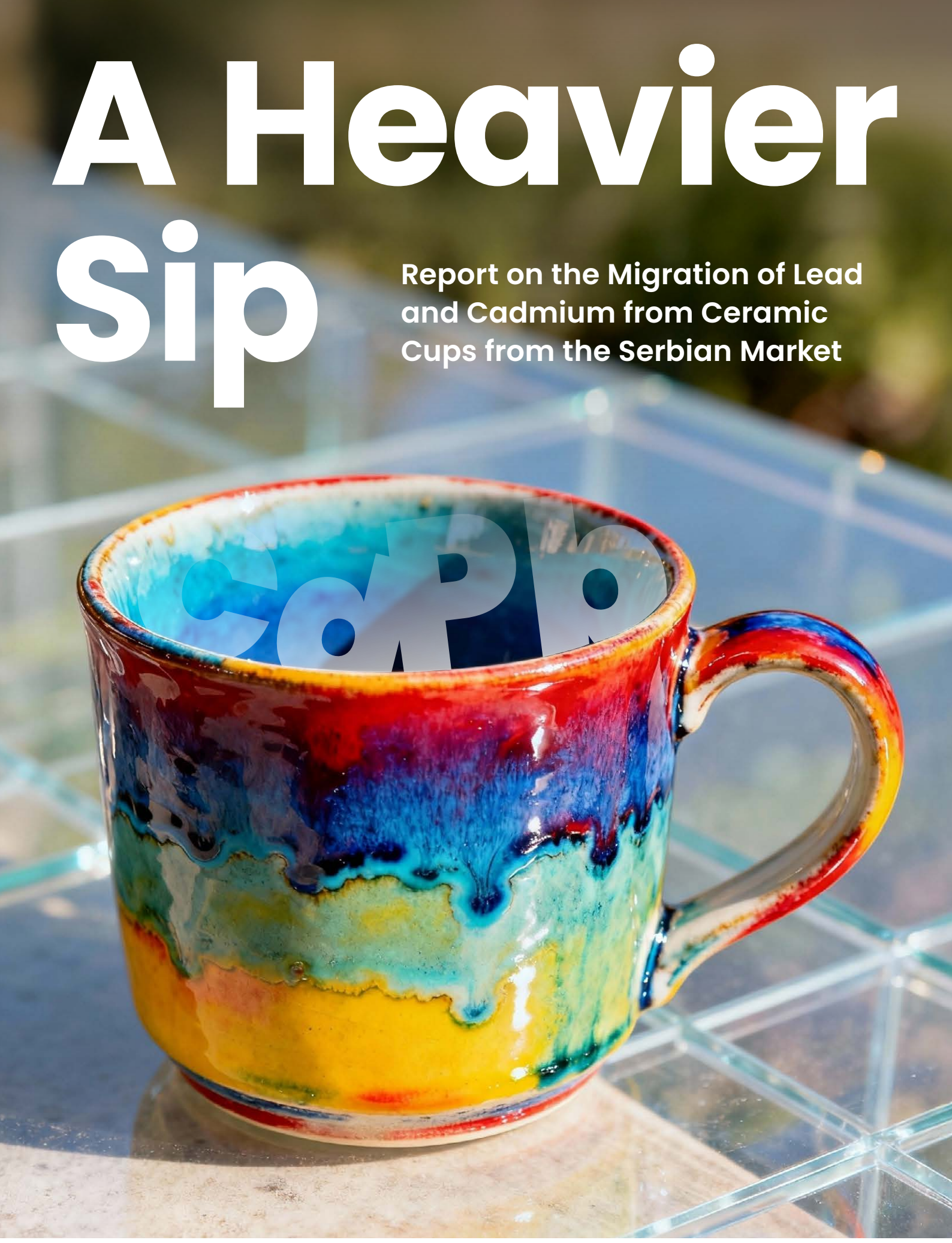
A Heavier Sip

Report on the Migration of Lead and Cadmium from Ceramic Cups from the Serbian Market



ALHem Alternativa za bezbednije hemikalije | Safer Chemicals Alternative

ARNIKA

TRANSITION

CZECH AID

A Heavier Sip

Report on the Migration of Lead and Cadmium from Ceramic Cups from the Serbian Market

ALHem Alternativa za bezbednije hemikalije | Safer Chemicals Alternative

ARNIKA

TRANSITION

CZECH AID

Authors:
Gordana Vraštanović Pavićević, Jasminka Ranđelović,
ALHem – Safer Chemicals Alternative (ALHem)

Supporting co-authors:
Markéta Möller, Karolína Brabcová
Arnika – Toxics and Waste Programme

Proof-reading:
Alexander Dionne, Joshua Meesarapu, Katie Morgan, Lyla Valentina

Graphic design:
Ondřej Petrlík, Martin Vimr

This report is published in English and Serbian.

ALHem - Safer Chemicals Alternative
Ivice Devčića 20/I, 11030 Belgrade, Serbia
email: office@alhem.rs;
website: https://alhem.rs/

Arnika – Toxics and Waste Programme
Seifertova 327/85, Praha 3, 130 00, Czech Republic
email: toxic@arnika.org;
website: www.arnika.org/en
Belgrade – Prague, November 2025

Table of Contents

Executive Summary

Safer Chemicals Alternative (ALHem) from Serbia and Arnika from the Czech Republic studied ceramic mugs for lead and cadmium migration to assess non-compliant products in Serbia. The research is part of the project *Educating the Young Generation for an Environmentally Responsible Serbia*, supported by the Czech Republic's Ministry of Foreign Affairs. The initiative aims to boost youth involvement in environmental advocacy and decision-making, with a focus on safe chemical management. ALHem works with two civil society organisations that specialize in working with young people — Protecta from Niš and BUM from Bečej — to engage young people in education, sample collection, laboratory testing, and outreach activities.

Laboratory testing for lead and cadmium migration was conducted by the Institute of Public Health "Dr Milan Jovanović Batut" during August and September 2025, using accredited methods for the required analyses. Test reports with results for all 30 samples were delivered upon completion.

Since ceramic mugs are among the most frequently used and durable household items, effective enforcement control is crucial. It has been recognised that lead and cadmium may migrate from their surfaces, posing a potential source of exposure and risk to human health, since pigments based on these heavy metals are still used for colouring and decoration.
The World Health Organisation (WHO) has classified lead and cadmium among the ten chemicals of primary public health concern due to their toxicity, emphasising that exposure should be reduced to the lowest possible level.

Given the serious adverse effects of increased exposure to lead and cadmium, especially among children, pregnant women, and young people, controlling all exposure sources — including migration from ceramic mug surfaces — can significantly reduce health risks and ensure a higher level of consumer protection. This is particularly relevant when modern standards and restrictions on the use of lead and cadmium in food-contact materials are applied, which is the focus of this research.

In the Republic of Serbia, materials and articles intended to come into contact with food are regulated by the *Law on Items of General Use*[1] and the *Rulebook on the Conditions Regarding the Health Safety of Items of General Use That Can Be Placed on the Market*[2], last amended in 1989, which covers cookware and food packaging. Requirements for ceramic cookware are defined in Articles 4, 5, and 22–23 of the Rulebook.

However, the migration limits for lead and cadmium, and the testing methodology specified in this Rulebook, are not harmonised with the EU Directive 84/500/EEC on the safety assessment of ceramic cookware[3], which was last revised in 2005 and is currently under further revision.

Of the 30 tested samples, 5 (17%) did not meet the Rulebook requirements for lead and cadmium migration.

1 Official Gazette of RS", No. 25/2019 and 14/2022
2 Official Gazette of the SFRY", Nos. 26/83, 61/84, 56/86, 50/89, 18/91, 60/2019 – other rulebook, and 78/2019 – other rulebook
3 Council Directive 84/500/EEC of 15 October 1984 on the approximation of the laws of the Member States relating to ceramic articles intended to come into contact with foodstuffs

Excessive lead migration from the outer surface was detected in 4 samples (13%) from a set of 6 mugs originating in China, bearing an Italian barcode, and purchased via an importer's Instagram account. Lead migration values ranged from 2.01 mg/dm² (12.06 mg/L) to 13.1 mg/dm² (78.6 mg/L) — 4 to 26 times higher than the maximum allowable limit of 3 mg/L. Simultaneously, cadmium migration from the outer surface of 2 mugs (6.5%) from the same set was 0.24 mg/L, which is 1.2 times above the maximum limit of 0.2 mg/L.

Cadmium migration from the inner surface was found in one sample (3%) purchased from a souvenir shop — originating from China but decorated in Serbia with a Serbian barcode — measuring 0.336 mg/L, or 1.7 times higher than the allowable limit of 0.3 mg/L.None of the samples showed lead migration from the inner surface above the permissible level; all were below the method's quantification limit.

The testing results were anticipated, mainly because most ceramic mugs are imported and subject to compliance control by the Border Sanitary Inspection of the Ministry of Health, which operates based on risk assessment prior to market placement. Colleagues with decades of laboratory experience in health safety testing and verification of domestic regulatory compliance for samples have frequently observed a significant proportion of mugs exhibiting lead and cadmium migration exceeding allowable limits. These products do not reach the marketplace, indicating that import controls performed through risk assessment are both effective and appropriately implemented.

However, the testing results for the four mugs purchased directly from the Instagram account of a retailer who is also the importer (and which were not available in retail stores) revealed that these coffee cups are unsafe for use, as lead migration from their outer surface (within 20 mm from the rim, the area that touches the lips during drinking) exceeded the maximum limit by 4 to 26 times. Cadmium levels in two samples were 1.2 times higher than allowed.

As ceramic mugs have long been recognised as food contact materials with a known risk of lead and cadmium migration, manufacturers have continued to improve their technologies (possibly by adding an extra glaze layer as a

protective barrier or by using pigments that are not lead- or cadmium-based) to meet safety requirements and thereby avoid financial losses and negative market reputation.

Nevertheless, online sales, particularly B2C (*business-to-consumer*) models, such as direct purchases from platforms without intermediaries or via social networks (e.g., Instagram), represent a growing global issue — including in the EU and the domestic market — as such products often bypass safety inspections and serve as channels for unsafe goods.

Since non-compliant products were identified on the market, ALHem will file a request with the Sanitary Inspection of the Ministry of Health of the Republic of Serbia for extraordinary inspection supervision, withdrawal of non-compliant products from the market, and product recall from consumers. Additionally, ALHem will request that the Ministry of Trade enter information about these non-compliant products and enforcement actions into the NEPRO Rapid Alert System for Unsafe Products in the Republic of Serbia, to ensure public access to such data.

Furthermore, within the project, ALHem – supported by other civil society organizations in Serbia and youth representatives — will submit an advocacy initiative to the Ministry of Health of the Republic of Serbia, urging accelerated adoption of a new *Rulebook on Materials and Articles Intended for Contact with Food*, harmonized with EU regulations and based on scientific principles, Serbian, European, and international standards, guidelines, and recommendations, to protect human health and the environment.

Alongside these advocacy efforts, a public awareness campaign will be conducted to educate consumers, especially young people, on making informed decisions when purchasing and using food-contact items.

Introduction

Safer Chemicals Alternative (ALHem) from the Republic of Serbia and Arnika from the Czech Republic conducted a study on ceramic mugs to test for lead and cadmium migration, intending to verify the presence of non-compliant ceramic products on the Serbian market.

The research was carried out within the project *Educating the Young Generation for an Environmentally Responsible Serbia*, financially supported by the Transition Promotion Program of the Ministry of Foreign Affairs of the Czech Republic. The project aims to increase youth participation in Serbia in advocacy and decision-making processes, as well as to improve dialogue and cooperation with decision-makers and other stakeholders in the field of health and environmental protection, with a particular focus on the safe management of chemicals. This project continues ALHem's youth engagement efforts under the *Youth for Healthy Serbia* Program, launched in 2024.

To achieve the project's objectives, ALHem, in cooperation with two civil society organisations — Protecta from Niš and BUM from Bečej — and with the youth communication coordinator, involved young people in activities related to education, sample selection and procurement for laboratory testing, advocacy, and communication.

The implemented activities ultimately aim to launch an advocacy initiative for complete harmonisation of national regulations with EU legislation in the field of food-contact materials and articles, to increase pressure on the competent inspection authorities to strengthen enforcement across all sales channels, and to raise public awareness of the importance of choosing safe food-contact products and their proper use.

An analysis of regulatory comparisons and laboratory analysis from prior joint activities by Arnika and ALHem indicates that the lack of alignment between Serbian and EU regulations poses a public health concern for Serbian residents, particularly regarding exposure to hazardous substances in consumer products[4,5,6].

Testing ceramic mugs for lead and cadmium migration is conducted to identify non-compliant products in both the domestic market and online.

4 https://en.alhem.rs/wp-content/uploads/2013/12/A4_2024-3.pdf
5 https://en.alhem.rs/wp-content/uploads/2013/12/SOFT-PLASTIC-HARSH-TRUE.pdf
6 https://en.alhem.rs/wp-content/uploads/2013/12/CRY-GAME.pdf

Legislation

EU Legislation on Materials and Articles Intended to Come into Contact with Food – with Reference to Ceramic Products

The European Union and all its Member States have long recognised the importance of harmonised regulation and control of materials and articles intended to come into contact with food, as they may pose a risk of contamination to food. A unified market must ensure equal protection of the health of all EU citizens.

In 2004, the European Commission adopted the "umbrella" regulation establishing general safety requirements for food-contact materials: REGULATION (EC) No 1935/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 October 2004 on materials and articles intended to come into contact with food and repealing Directives 80/590/EEC and 89/109/EEC. The latest revision of this Regulation was adopted in 2021.

This Regulation also established the Rapid Alert System for Food and Feed (RASFF) to ensure information exchange among Member States and to support rapid responses by food safety authorities — including for food-contact materials (FCM). When risks to public health are identified along the food chain, notifications of unsafe food-contact products, test results, and decisions on corrective actions are published on the RASFF portal. Each year, the Alert and Cooperation Network (ACN) of the European Commission publishes an annual report analysing risks and notifications concerning unsafe products (food, feed, and FCM) based on the previous year's data.

In addition to Regulation No 1935/2004, the Commission Regulation (EC) No 2023/2006 of 22 December 2006 on Good Manufacturing Practice (GMP) for materials and articles intended to come into contact with food was adopted. This regulation is of exceptional importance to all manufacturers, importers, and distributors. Its latest revision was adopted in 2025.

For the safety assessment of ceramic cookware, the following directive applies in EU Member States: Council Directive 84/500/EEC of 15 October 1984 on the approximation of the laws of the Member States relating to ceramic articles intended to come into contact with foodstuffs, which was last revised in 2005 and is currently undergoing another revision.

However, since a directive is not directly binding, Member States implement their objectives through their national legislation, which may be stricter. Consequently, several EU countries are already considering national regulations to further limit migration of lead and cadmium from ceramic cookware, thereby lowering public exposure to these toxic elements.

For example, in 2021, the German Federal Institute for Risk Assessment (BfR) issued a Position Statement[7] recommending that the maximum migration limits for ceramic articles in Category 1 (flatware and plates) be set at 2 µg Pb/dm² and 1 µg Cd/dm². These values are 70 times lower for cadmium (0.07 mg/dm²) and 400 times lower for lead (0.8 mg/dm²) than the current limits. BfR further recommends that these significantly lower limits be included in the forthcoming revision of the

7 Geschirr aus Keramik: BfR empfiehlt niedrigere Freisetzungsmengen für Blei und Cadmium - Stellungnahme Nr. 043/2020 des BfR vom 21. September 2020

directive, especially for ceramic cookware intended for children.

Regarding ceramic mugs (classified as Category 2), the Danish National Food Institute proposed to lower the maximum migration limits for lead and cadmium from ceramic, glass, and enamelled materials in contact with food[8] in December 2024. The proposed limits are 1.5 µg/L for lead (2,660 times lower than the current limit) and 0.7 µg/L for cadmium (428 times lower than the current limit).

Many EU Member States have already recognised that the existing EU directive allows the marketing of food-contact products that may be among the primary sources of consumer exposure to lead and/or cadmium, thereby increasing health risks. Therefore, measures are being taken to reduce these risks, and it is expected that an updated version of the current directive will soon be adopted in the EU, setting significantly lower maximum migration limits for lead and cadmium from ceramic cookware.

Legislation in the Republic of Serbia and Analysis of Alignment with EU Regulations on Food-Contact Materials and Articles, with Reference to Ceramic Cookware

In the Republic of Serbia, the basic safety principles, obligations of business operators, and the supervision system for materials and articles intended to come into contact with food are regulated by the following legal acts:

1. Law on Items of General Use ("Official Gazette of RS", Nos. 25/2019 and 14/2022)
2. Rulebook on the Conditions Regarding the Health Safety of Items of General Use That Can Be Placed on the Market ("Official Gazette of SFRY", No. 26/83, 61/84, 56/86, 50/89, 18/91, 60/2019 - amended rulebook, and 78/2019 - amended rulebook)

The Law of Items of General Use is harmonised with REGULATION (EC) No 1935/2004 and Commission Regulation (EC) No 2023/2006 in Articles 28–38, covering the following areas: general requirements, labelling, declaration of conformity, traceability, and general good manufacturing practice (GMP) requirements.

The Rulebook on the Conditions Regarding the Health Safety of Items of General Use That Can Be Placed on the Market defines more explicitly the safety conditions for cookware, utensils, and food packaging. The last update of the sections related to these items was in 1989.

This Rulebook has not been harmonized with EU legislation concerning the following materials: plastics, recycled plastics, ceramics, active and intelligent materials, and regenerated cellulose; nor with EU regulations on specific substances in food-contact materials such as vinyl chloride monomers, N-nitrosamines and their precursors, certain epoxy derivatives, bisphenol A and other bisphenols, or with the regulation on special conditions and detailed procedures for the import of polyamide and melamine plastic kitchenware originating from or consigned from the People's Republic of China and the Hong Kong Special Administrative Region of China.

Requirements for ceramic cookware are specified in Articles 4, 5, and 22–23 of the Rulebook.

However, the testing conditions, maximum allowable migration values for lead and cadmium, as well as the testing methodology, are not harmonised with Council Directive 84/500/EEC of 15 October 1984 on the approximation of the laws of the Member States relating to ceramic articles intended to come into contact with foodstuffs.

A detailed comparison of the requirements set out in the EU Directive 84/500/EEC and the Serbian Rulebook is presented in Table 1.

8 DTU National Food Institute, Technical University of Denmark, Suggestive maximum limits for lead and cadmium in food contact materials, 12th of December 2024, DTU DOCX no. 24/1014518. 12_12_2024_Forslag_til_gr_nsev_rdier_for_Pb_og_Cd_i_FKM.pdf

Table 1. Comparison of the Requirements of EU Directive 84/500/EEC and the Serbian Rulebook on the Health Safety Requirements for General Use Articles that May be Placed on the Market — for lead and cadmium in Ceramic Cookware

EU			Republic of Serbia
Council Directive 84/500/EEC of 15 October 1984 on the approximation of the laws of the Member States relating to ceramic articles intended to come into contact with foodstuffs			Rulebook on the Conditions Regarding the Health Safety of Items of General Use That Can Be Placed on the Market ("Official Gazette of SFRY", No. 26/83, 61/84, 56/86, 50/89, 18/91, 60/2019 - amended rulebook, and 78/2019 - amended rulebook), Article 23
Test conditions: 4% (v/v) acetic acid, 22 ± 2°C for 24 ± 0.5 h			**Test conditions:** 3% (v/v) acetic acid, 20 ± 2°C for 24 h
Migration limit of lead and cadmium:	**Pb**	**Cd**	**Migration limit:** 3 mg/L of lead, 0,2 mg/L of cadmium, in a 3% (v/v) acetic acid solution The provisions of paragraph 1 of this article also apply to the outer surface of the vessel within 20 mm from the upper rim of the vessel
Category 1: Articles which cannot be filled and articles which can be filled, the internal depth of which, measured from the lowest point to the horizontal plane passing through the upper rim does not exceed 25	0.8 mg/dm^2	0.07 mg/dm^2	
Category 2: All other articles which can be filled	4.0 mg/L	0.3 mg/L	
Category 3: Cooking ware, packaging and storage vessels having a capacity of more than three litres	1.5 mg/L	0.1 mg/L	
Defined LOD and LOQ of the method, defined non-compliance conditions (testing of at least 4 items from the same batch), basic testing principles in relation to EN 1388-1:1995 (internationally recognized test and testing conditions for the cup rim — "drinking rim," 20 mm from the edge)			The Rulebook does not clearly define the testing and calculation methodology for the outer surface and is not harmonized with SRPS EN 1388-1:2009 Materials and articles in contact with foodstuffs – Silicate surfaces – Part 1: Determination of the release of lead and cadmium from ceramic ware (identical to EN 1388-1:1995)

Insufficient harmonisation between Serbian and EU legislation on food contact materials and articles poses potential public health risks to the population of the Republic of Serbia. This regulatory discrepancy increases exposure to hazardous chemicals such as lead and cadmium, which may migrate into food from cookware surfaces. The current Rulebook governing lead and cadmium migration does not differentiate between various categories of ceramic ware, as specified in EU Directive 84/500/EEC. Instead, it applies a uniform criterion to all ceramic cookware — including a calculated migration value from the exterior surface measured 20 mm below the vessel's upper rim. This approach constitutes a considerable risk, as it does not impose stricter standards for frequently used ceramic cookware that is more prone to higher migration of these elements. Of particular concern are ceramic vessels exceeding 3 litres in capacity, commonly used for cooking, packaging, and extended food storage, and which correspond to Category 3 under EU Directive 84/500/EEC.

Also, the lack of alignment between the Republic of Serbia's regulations and those of the European Union regarding materials and articles intended to come into contact with food poses a significant challenge for all economic operators engaged in the import, distribution, production, and export of such products. This misalignment leads to increased business costs, the potential for incomplete or incorrect implementation of regulations, mutual non-recognition among EU Member States, and obstacles to the free movement of goods.

This issue of non-alignment is particularly pronounced for importers of food-contact materials and articles, including ceramic cookware, due to the relatively small size of the domestic market. The largest global producers of ceramic tableware — including China, Turkey, Spain, Italy, Germany, and Portugal — have no economic incentive to adapt their production to the Republic of Serbia's specific national regulations. However, they do have a substantial financial interest in ensuring compliance with EU legislation, which covers a far larger and more unified market.

Nevertheless, manufacturers of ceramic mugs, if they use any substance or mixture, are required to align their operations as downstream users in accordance with the Law on Chemicals ("Official Gazette of RS", Nos. 36/2009, 88/2010, 92/2011, 93/2012, and 25/2015) and its subordinate regulations, which are mostly harmonised with EU legislation.

Lead (Pb) and Cadmium (Cd)

Lead and cadmium are naturally occurring chemical elements found in small quantities in the Earth's crust. The average concentration of lead in the Earth's crust is about 15 ppm (mg/kg)[9], while cadmium is present in much smaller amounts, around 0.1–0.5 ppm (mg/kg)[10]. Although naturally present in ores, soil, rocks, and water, their concentrations can increase due to human activities such as mining, metal smelting, combustion of petroleum products, and industrial production.

Lead was once widely used in various products (e.g., leaded gasoline, paints, and water pipes). Still, its use today is primarily restricted to the production of batteries, accumulators, alloys, radiation shielding, electronic devices, pigments in paints, ceramics, and glass.

Lead-based pigments and glazes have been used to decorate ceramics for over 3,000 years, making them among the oldest known technologies in ceramic art and craftsmanship. Lead was historically added to glazes because it lowered the melting point and gave ceramics a shiny, glass-like appearance. However, due to lead's high toxicity, lead glazes are no longer used. Nevertheless, pigments used to decorate ceramic products are still applied in some instances.

Cadmium is primarily used in the production of nickel-cadmium batteries, non-ferrous metal processing, and is also a component of pigments, coatings, platings, and plastic stabilisers. Due to their unique characteristics, cadmium-based pigments are used as colourants in plastics, paints for fine arts, ceramic, glass, and enamelled cookware, and in other artistic fields.

Cadmium pigments appeared much later, in the 19th century. Cadmium compounds are used to obtain bright yellow, orange, and red hues, especially in decorative ceramics and glass.

Risks of Lead and Cadmium to Human Health

The World Health Organisation (WHO) has classified lead and cadmium among the top ten chemicals of primary public health concern due to their high toxicity[11].

According to the Rulebook on the List of Classified Substances ("Official Gazette of RS", No. 11/2025), the hazard classification of lead and cadmium is as follows:

- Lead (CAS: 7439-92-1) is classified in the following hazard classes and categories: Reproductive toxicity 1A, Reproductive toxicity (lactation), Aquatic acute 1, and Aquatic chronic 1. The list also includes 21 lead compounds with different hazard classifications.
- Cadmium (CAS: 7440-43-9) is classified in the following hazard classes and categories: Carcinogenicity 1B, Germ cell mutagenicity 2, Reproductive toxicity 2, Acute toxicity 2, Specific target organ toxicity (STOT) – repeated exposure 1, Aquatic acute 1, and Aquatic chronic 1. The list also contains 21 cadmium compounds with different hazard classifications.

9 Geological Survey Professional Paper 957 „Lead in the Environment", t. g. Lovering, editor, US government printing office, Washington: 1976, p.1: https://pubs.usgs.gov/pp/0957/report.pdf?utm_source=chatgpt.com

10 Faroon O, Ashizawa A, Wright S, et al., Toxicological Profile for Cadmium- 2.Relevance to public health, 2.1. Background and environmental exposures to cadmium in the United States, Atlanta (GA): Agency for Toxic Substances and Disease Registry (US); 2012 Sep., National Library of Medicine https://www.ncbi.nlm.nih.gov/books/NBK158838/

11 https://www.who.int/news-room/photo-story/detail/10-chemicals-of-public-health-concern

Lead is a toxic metal which humans may be exposed to in both living and working environments. The most common sources of exposure include dust, contaminated air, soil, water, and food. In food, lead contamination can occur due to migration from cookware and utensils used for food preparation and serving — particularly those made of ceramics, glass, or enamel, as well as from food packaging materials.

Lead is known to have harmful effects on all human organs, and no safe level of lead in blood has been established. Scientific research shows that lead exposure causes neurotoxic effects, especially in children and fetuses, where it can affect brain development, reduce IQ, and cause learning and concentration difficulties. The harmful effects of lead on the nervous system are irreversible, making it extremely dangerous to human health, particularly for children[12].

Increased lead exposure may also cause reproductive issues, such as a higher risk of miscarriage, premature birth, and low birth weight. In addition, lead can lead to kidney damage and cardiovascular problems[13]. Lead accumulates in the bones, from which it can re-enter the bloodstream at any time, causing toxic effects on other organs and reducing bone resistance to fractures, especially in elderly individuals[14].

Cadmium, like lead, is a toxic metal present in both the environment and the workplace. Numerous scientific studies highlight the consequences of occupational and general population exposure to this harmful chemical, particularly among children, through food consumption.

Cadmium occurs naturally in the Earth's crust and volcanic ash, but it is also released through industrial pollution, improper waste disposal, and incineration of electronic waste. Although cadmium's biological availability is relatively low, acid rain — resulting from industrial air pollution — can convert it into a soluble form that can be absorbed by plants and animals, subsequently entering the human food chain.

Certain plants, such as rice and cocoa, naturally absorb cadmium from soil and accumulate it, which is why continuous monitoring of cadmium levels in products derived from these crops is essential.

The adverse health effects of cadmium are numerous, including kidney disease, bone damage, lung and nervous system disorders, hypertension, and disruption of sex hormone regulation and activity (as an endocrine disruptor)[15]. These effects may manifest in adulthood after long-term exposure, but cadmium's impact on pregnant women and children — due to their higher vulnerability — must not be overlooked. Early life exposure to cadmium has been linked to impaired cognitive function and behavioural problems. Research data also suggest that cadmium exposure can weaken the immune system of children.

The International Agency for Research on Cancer (IARC) has classified cadmium and its compounds as carcinogenic to humans, associating them primarily with lung cancer, and potentially with kidney, prostate, bladder, pancreatic, and reproductive organ cancers[16].

12 Aleksandra Buha Đorđević et al. Informator „Informisana mama, zdrava beba – kako bezbedno živeti sa hemikalijama", Udruženje toksikologa Srbije, Vojvode Stepe 450, Beograd www.setox.rs, 2022, p.50-55, 86-91

13 Ana Navas-Acien et al. „Lead exposure and cardiovascular disease--a systematic review", PubMed, PMID: 17431501 PMCID: PMC1849948 DOI: 10.1289/ehp.9785, Environ Health Perspect, 2007 Mar;115(3):472-82. doi: 10.1289/ehp.9785. Epub 2006 Dec 22. (https://pubmed.ncbi.nlm.nih.gov/17431501/)

14 https://www.who.int/news-room/photo-story/detail/10-chemicals-of-public-health-concern

15 https://www.gov.uk/government/publications/cadmium-properties-incident-management-and-toxicology/cadmium-toxicological-overview

16 IARC Monografija – Volumen 100C: Arsenic, Metals, Fibres, and Dusts (2012) https://publications.iarc.who.int/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Arsenic-Metals-Fibres-And-Dusts-2012?utm_source=chatgpt.com

Therefore it is evident that preventive measures and exposure control are essential, given the numerous harmful effects caused by cadmium.

Migration of Pb and Cd from Tableware into Food

Since the intake of harmful elements through food — particularly lead (Pb) and cadmium (Cd) — poses a threat to human health, all necessary measures must be taken to reduce human exposure. Recent risk assessments by the European Food Safety Authority (EFSA) and the Joint FAO/WHO Expert Committee on Food Additives (JECFA) have shown that the Provisional Tolerable Weekly Intake (PTWI) values for lead and cadmium do not guarantee health safety and therefore require revision[17].

Migration of lead and cadmium from ceramic, glass, and enamelled cookware intended for contact with food is a significant source of intake. Therefore, these types of cookware are subject to continuous and systematic control[17].

"Ceramic articles" intended for contact with food are defined as products made from a mixture of inorganic materials with a high clay or silicate content, which may include small amounts of organic materials. These products are first shaped and then permanently hardened by firing. They may be glazed, enamelled, and/or decorated[18].

Ceramic cookware, particularly mugs, are among the most commonly used household items. They are easy to clean and maintain, durable, resistant to damage or breakage, and thus remain in use for long periods. Ceramic dishes can be used at both high and low temperatures and for all types of food, without restrictions on pH or fat content.

The glaze mixture is composed of silicates and metal oxides, which, when fired at high temperatures, melt and form a glassy film on the surface of the vessel[19]. This layer serves multiple functions: it prevents liquid absorption, facilitates cleaning, provides shine and colour, prevents direct contact of food with the porous ceramic material and decorative paints, and enhances mechanical and chemical resistance.

Manufacturers of ceramic mugs and decorative items use these glaze properties to create an "impermeable" barrier to the migration of lead, cadmium, and other elements from decorated surfaces, typically by applying an additional glazing layer after decoration.

However, even a glazed surface is not completely inert and may not provide an adequate barrier, allowing heavy metals, especially those used in decoration, to migrate from the inner layers. High temperatures, prolonged contact time, and acidic foods or beverages are key factors that promote migration.

For this reason, laboratory testing simulates such extreme use conditions to assess product safety and compliance with regulations on lead and cadmium migration.

Testing is conducted on surfaces that come into direct contact with food or beverages, as well as on the outer surface within 20 mm of the rim (the drinking rim)[20], since the mouth

17 Małgorzata Rebeniak et al., Exposure to lead and cadmium released from ceramics and glassware intended to come into contact with food, PubMed, PMID: 25526575, Rocz Panstw Zakl Hig. 2014; 65(4):301-9. (https://pubmed.ncbi.nlm.nih.gov/25526575/)

18 Council Directive 84/500/EEC of 15 October 1984 on the approximation of the laws of the Member States relating to ceramic articles intended to come into contact with foodstuffs

19 G. Beldì, N. Jakubowska, M.A. Peltzer and C. Simoneau , Testing approaches for the release of metals from ceramic articles, In support of the revision of the Ceramic Directive 84/500/EEC, Joint Research Centre (JRC), the European Commission's science and knowledge service , JRC102075 EUR 28363 EN, PDF ISBN 978-92-79-64640-9 ISSN 1831-9424, doi:10.2788/402683 016, 2016

20 Official Gazette of the SFRY", No. 26/83, 61/84, 56/86, 50/89, 18/91, 60/2019 – other rulebook, and 78/2019 – other rulebook, Article 23

comes into contact with this area during drinking, creating a potential for lead and cadmium migration. In this way, these elements can enter the human body together with food or drink.

This presents a recognised risk, particularly when these surfaces are decorated with pigments containing lead or cadmium.

Rapid Alert Systems in the EU for Food and Feed and the Republic of Serbia for Unsafe Products

In the European Union, a Rapid Alert System known as the RASFF portal (Rapid Alert System for Food and Feed) has been established to ensure the exchange of information among Member States and to support rapid responses by food safety authorities, including in cases involving materials and articles intended to come into contact with food.

The system operates in instances of risk notifications concerning public health arising from food sources. The RASFF portal also publishes notifications of unsafe food-contact materials, including ceramic cookware, as well as testing results and decisions on the measures taken.

In the annual reports of the RASFF portal, a consistent number of notifications related to ceramic cookware due to lead and/or cadmium migration are recorded each year. This consistency highlights the need for continuous monitoring and control. A tabular overview of RASFF notifications concerning lead and cadmium migration from ceramic cookware for the period 2021 to September 2025 is presented in Annex III of this report.

In the Republic of Serbia, there exists a national rapid alert system for dangerous products — the NEPRO portal, administered by the Ministry of Trade. This system is part of a broader market surveillance framework and aims to improve consumer protection, educate all market participants, and raise public awareness about the importance of product safety.

Upon reviewing and analysing the data published in the NEPRO system over recent years, and comparing them with data from the annual reports of the Sanitary Inspection Department, ALHem concluded that there is insufficient coordination and information exchange between the sanitary and market inspection authorities. Furthermore, data on products withdrawn

from the Serbian market due to chemical risks is inconsistent, and the NEPRO portal requires significant improvement to ensure that such information is publicly available to citizens of Serbia[21].

According to the Law on General Use Articles ("Official Gazette of RS", Nos. 25/2019 and 14/2022), Article 22 stipulates that:

A business operator dealing with general-use items is obliged to undertake appropriate actions, proportionate to the level of risk, and to notify the Ministry of Health, the sanitary inspector, and the public if officially informed by the Ministry or the sanitary inspector that a general-use article is unsafe for health.

When unsafe or non-compliant general-use articles have already reached consumers, the business operator must promptly and clearly inform consumers of the reasons for the product recall, and, if necessary, request the return of products already distributed to consumers if a high level of health protection cannot be achieved through other measures. The operator must also notify the Ministry and the public in writing. The costs of product withdrawal or recall are borne by the business operator responsible for the health non-compliance or unsafe condition of the product.

The destruction of unsafe general-use articles must be carried out in a safe and environmentally sound manner, in accordance with waste management regulations, ensuring no harm to human health or the environment.

The business operator must notify the sanitary inspector in writing of the location, date, and quantity of the destroyed products and provide evidence that the destruction was properly carried out. The costs of destruction are borne by the business operator responsible for the non-compliance or unsafe condition of the products.

21 K27-izvestaj-2025-EN.pdf

Results of the Laboratory Testing

Selection and Purchase of Products

The purchase of ceramic mugs was conducted at retail locations identified as the most common points of sale for such products, based on an analysis of a survey on consumer habits and preferences regarding the purchase of ceramic mugs, as well as paper and cardboard materials and articles intended for food contact[22]. The survey was implemented within the framework of the project *Educating the Young Generation for an Environmentally Responsible Serbia*.

The purchases were primarily made in general merchandise stores — i.e., shops offering a wide range of household goods — and specialised homeware stores, souvenir shops, bookstores with accompanying gift programs, and artisan workshops.

However, due to the recognised quality risks associated with shops selling exclusively low-cost imported goods from China, the increasing prevalence of online shopping and purchases made via social networks (most frequently Instagram), several ceramic mugs were purchased through these channels. The purchase locations are presented in Table 2.

Excluding the manufacturer of the ceramic mugs, i.e. the barcode owner, an examination of the country of origin revealed that, out of the total number of purchased mugs, 80% were manufactured in China (24 out of 30), 13% were produced in Serbia (4 out of 30), and 7% (2 out of 30) originated from Turkey.

Table 2. Locations of Sample Purchases

Purchase location	number of samples	Sample code
general merchandise stores	10	ALH-3A, ALH-4A, ALH-6A, ALH-7A, ALH-12A, ALH-16A, ALH-19A, ALH-20A, ALH-21A, ALH-30A
souvenir shops	3	ALH-1A, ALH-2A, ALH-14A
bookstores with gift sections	4	ALH-5A, ALH-8A, ALH-11A, ALH-15A
craft and art workshops	2	ALH-9A, ALH-10A
Chinese goods stores	3	ALH-13A, ALH-17A, ALH-18A
online purchases (via platforms such as Temu, Shein, AliExpress, and retailers' Instagram account)	8	ALH-22A, ALH-23A, ALH-24, ALH-25A, ALH-26A, ALH-27A, ALH-28A, ALH-29A

22 Survey on habits and preferences when buying ceramic cups and materials and objects made of paper and cardboard that come into contact with food, conducted via social networks in May 2025 by student researcher Mila Marić.

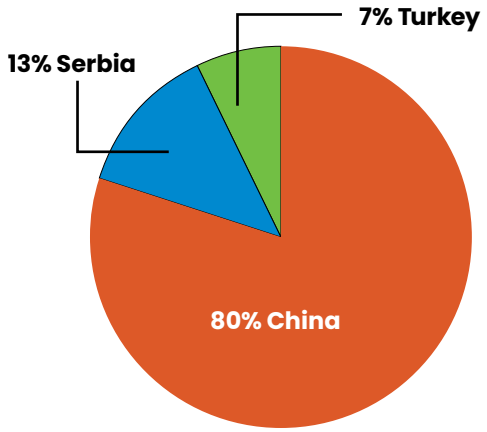


Figure 1. Graphical representation of the distribution of purchased samples by country of origin

Testing of Pb and Cd Migration

The testing of lead (Pb) and cadmium (Cd) migration from the inner surface and from the outer surface within 20 mm from the upper rim of each mug sample was carried out in accordance with the requirements of the *Rulebook on the Conditions Regarding the Health Safety of Items of General Use That Can Be Placed on the Market ("Official Gazette of the SFRY", Nos. 26/83, 61/84, 56/86, 50/89, 18/91, 60/2019 – supplementary rulebook, and 78/2019 – supplementary rulebook).*

According to Article 23 of this Rulebook, the migration limits of the tested elements are 3 mg of lead and 0.2 mg of cadmium per 1 litre of a 3% (v/v) acetic acid solution over 24 hours at a temperature of 20 °± 2 °C. These provisions also apply to the outer surface of the vessel within 20 mm of the upper rim.

The testing was performed in August (samples ALH-1 to ALH-20) and September (ALH-21 to ALH-30) 2025, in a laboratory accredited in accordance with the requirements of standard SRPS ISO/IEC 17025:2017, using a validated and documented method.

In total, 30 samples were tested, and for each sample, the migration of lead and cadmium was examined from both the inner and outer surfaces within 20 mm of the mug's upper rim.

Laboratory Testing Method

Laboratory testing of lead (Pb) and cadmium (Cd) migration from the surfaces of ceramic mugs was conducted at the Institute of Public Health "Dr Milan Jovanović Batut" in Belgrade, within the Centre for Hygiene and Human Ecology, Department of Ecotoxicology Laboratories.

The applied method, VDM-10, is accredited in accordance with the requirements of standard SRPS ISO/IEC 17025:2017[23]. The testing methodology includes the following stages: sample pre-treatment, the migration process (exposure of the test surfaces to the model solution), determination of the element concentrations in the model solution after migration, calculation of the obtained values into appropriate measurement units, and comparison with the maximum permitted migration values as prescribed by the Rulebook.

The sample pre-treatment process includes washing with a dishwashing detergent solution, rinsing with tap and distilled water, and drying. The tested surfaces were then exposed to a 3% (v/v) acetic acid model solution for 24 hours in a thermostatic chamber at 20 °± 2 °C.

Migration testing from the inner surface of the mug was performed by filling the mug with an appropriate volume of the model solution. Migration testing from the outer surface was performed by immersing the mug in a proper volume of the model solution up to 20 mm from the upper rim. After the migration process, the exposed surface area (dm²) was calculated.

The concentrations of Pb and Cd in the model solutions after migration were determined using ICP/OES (*Inductively Coupled Plasma – Optical Emission Spectrometry*). The obtained

23 Scope of accreditation: Accreditation number 01-130, SCOPE OF ACCREDITATION, Accredited conformity assessment body, Institute for Public Health of Serbia "Dr. Milan Jovanović Batut" Center for Hygiene and Human Ecology, Belgrade, Dr. Subotića 5, SRPS ISO/IEC 17025:2017.

concentrations of Pb and Cd (expressed in mg/L) represent the migration values of each element, expressed in mg/L of food simulant.

For the tested portion of the sample — the outer surface of the mug — the migration of Pb and Cd was calculated and expressed in mg/dm², using the concentrations of each element in the model solution, the exposed surface area, and the volume of the model solution.

For comparison with the maximum permitted migration values (MPM) prescribed in Article 23 of the Rulebook, a correlation factor of 6 (*1 L = 1 dm³ = 6 dm²*) was applied, since Article 23 specifies the testing of the outer surface, but expresses the migration limit in mg/L.

Laboratory Test Results in the Examined Samples

Upon completion of the testing and receipt of the laboratory reports, it was determined that:

- 17% of the samples, i.e., five tested samples, did not meet the requirements of the Rulebook regarding the migration of lead and cadmium (Figure 2).

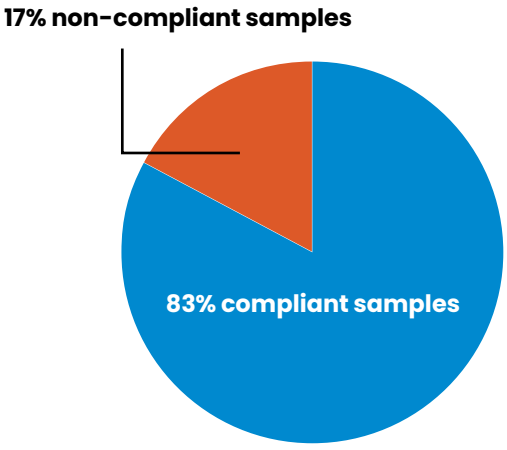


Figure 2. Laboratory testing results

Of these:

- Lead migration exceeding the maximum permitted limit from the outer surface of the mugs was detected in 4 samples (13%), originating from a set of six mugs manufactured in China, bearing an Italian barcode, and purchased via the Instagram account of an importer and retailer. The measured lead migration values ranged from 2.01 mg/dm² (12.06 mg/L) to 13.1 mg/dm² (78.6 mg/L), which is 4 to 26 times higher than the maximum permitted migration value of 3 mg/L. At the same time, for two mugs (6.5%) from the same set, the cadmium migration from the outer surface was 0.24 mg/L, i.e. 1.2 times higher than the maximum permitted migration value of 0.2 mg/L (*Figures 3 and 4*).
- Cadmium migration from the inner surface was found to exceed the maximum permitted value in one sample (3%), purchased from a souvenir shop, manufactured in China but

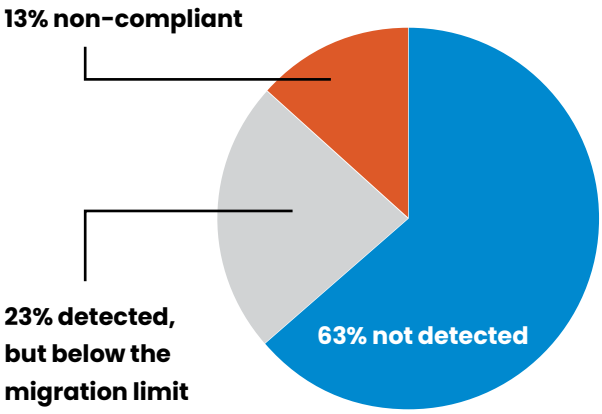


Figure 3. Graphical representation of Pb migration results from the outer surface

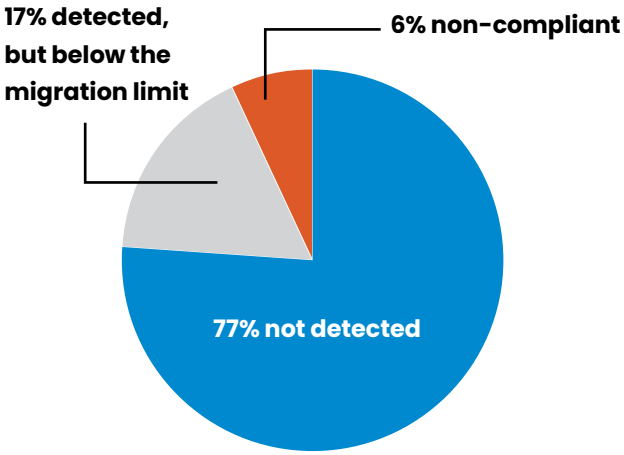


Figure 4. Graphical representation of Cd migration results from the outer surface

decorated in Serbia. The measured migration value was 0.336 mg/L, which is 1.7 times higher than the maximum permitted migration limit of 0.2 mg/L (*Figure 5*).

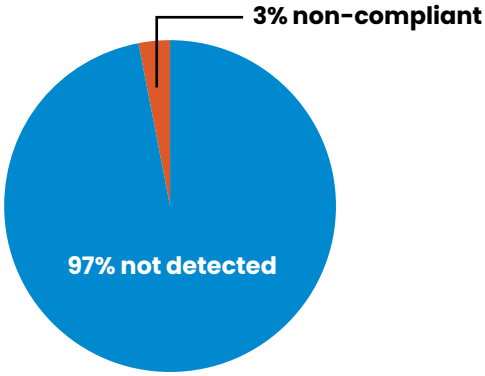


Figure 5. Graphical representation of Cd migration results from the inner surface

- None of the tested samples exhibited lead migration from the inner surface exceeding the maximum permitted limit. For all tested samples, lead migration values were below the analytical method's quantification limit (*Figure 6*).

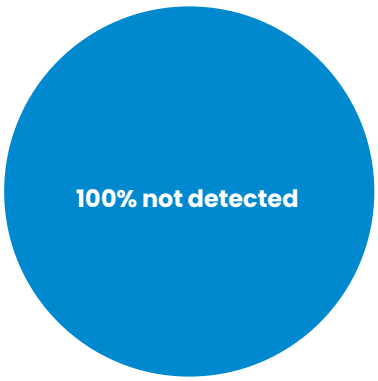


Figure 6. Graphical representation of Pb migration results from the inner surface

Legend: *Results marked in the graphical representations as "not detected" indicate element concentration values that are below the limit of quantification of the applied method. The limit of quantification (LOQ) is the lowest concentration of a substance that can be quantitatively measured by the applied method with acceptable accuracy and repeatability.*
The LOQ values for lead migration are <0.02 mg/l and <0.003 mg/dm²; those for cadmium migration are <0.003 mg/l and <0.001 mg/dm². These represent the limits of quantification of the applied test method.

- Migration of both elements — lead (Pb) and cadmium (Cd) — exceeding the maximum permitted limits from the outer surface of the mug was detected in 2 samples (29% of the total number of non-compliant samples). These were mugs from a set of six pieces, manufactured in China, and purchased via the Instagram account of an importer and retail trader (*Figure 7*).

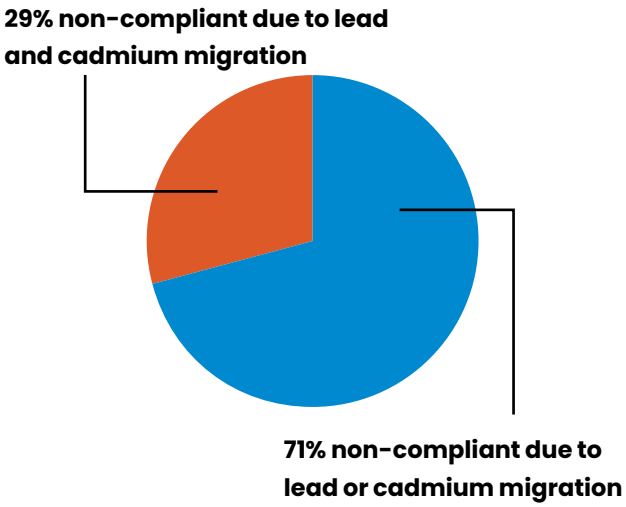


Figure 7. Graphical representation of migration results for both elements from the outer surface

Discussion and Conclusions

The testing results were anticipated, mainly because most ceramic mugs are imported and subject to compliance control by the Border Sanitary Inspection of the Ministry of Health, which operates based on risk assessment prior to market placement. Colleagues with decades of laboratory experience in health safety testing and verification of domestic regulatory compliance for samples have frequently observed a significant proportion of mugs exhibiting lead and cadmium migration exceeding allowable limits. These products do not reach the marketplace, indicating that import controls performed through risk assessment are both effective and appropriately implemented.

Given the absence of regularly based and completed public reports on ceramic product testing in the Republic of Serbia, the research findings presented in this project may represent the first publicly available report on the subject.

Given that the manufacturing process of ceramic mugs is specific in terms of the raw materials, facilities, and energy sources used, both the material damage (such as lost revenue and the obligation to manage non-compliant products) and the non-material damage (such as reputational loss and diminished consumer trust) resulting from the production of non-compliant ceramic mugs are significant. Therefore, manufacturers strive to prevent such occurrences by adjusting production processes, implementing internal controls, substituting pigments, and closely following regulatory requirements. The broader availability of information enabled by the development of information technologies—including access to global regulatory frameworks, data on the risks of heavy-metal migration from ceramic ware, and safer decorative alternatives – allows even small-scale ceramic producers to comply with regulatory standards, which is in the overall public interest.

As ceramic mugs have long been recognised as food contact materials with a known risk of lead and cadmium migration, manufacturers have continued to improve their technologies to meet safety requirements and thereby avoid financial losses and negative market reputation. This is most likely why the testing results showed that all mugs purchased through retail outlets (except one sample), including those purchased online via popular platforms, complied with the Rulebook requirements. The only sample purchased from retail outlets that exceeded the legal limits for tested heavy metals was a sample ALH–14A. In this mug, cadmium migration from the inner surface was detected at 0.336 mg/L, i.e., 1.7 times the maximum permitted migration value.

However, the test results for four mugs (ALH-26A, ALH-27A, ALH-28A, and ALH-29A) purchased directly via the Instagram account of a retail trader who also acts as an importer, are of particular importance. These mugs were not available in physical retail stores. According to the testing results, these espresso cups are unsafe for use, as their outer surface within 20 mm from the rim (the area that comes into contact with the mouth during drinking) exhibited lead migration levels 4 to 26 times higher than the migration limit, as well as cadmium migration in two samples at concentrations 1.2 times higher than the migration limit.

Based on the above and considering the total number of tested samples and points of

purchase, it can be concluded that manufacturers have responded to increased inspection oversight by improving their production methods—possibly by applying an additional glazing layer as a protective barrier or by using non-lead and non-cadmium-based pigments. This may also have been influenced by the rapid, global dissemination of information, including through rapid alert systems for unsafe food contact materials, such as the EU RASFF. Nevertheless, a relevant question remains: which other elements are currently used in pigments, and whether they may migrate from the mug surface, given that these elements are not tested and/or not yet regulated.

Finally, online sales, and in particular the B2C (business-to-consumer) models such as purchases through platforms where transactions occur without importers and products are shipped directly to individual consumers, as well as sales via social media, most commonly Instagram, represent an increasing global challenge, including within both the EU and the domestic market. Products sold through such channels circumvent mandatory regulatory controls and frequently serve as conduits for unsafe goods.

Considering the results obtained in this research, ALHem will submit a request for extraordinary inspection supervision to withdraw non-compliant products from the market and recall them from consumers, as well as to establish regular monitoring of ceramic food-contact items. In addition, ALHem will request that the ministry responsible for trade affairs include information on the non-compliant products and the measures taken in the NEPRO Rapid Alert System for Unsafe Products in the Republic of Serbia, as part of the market surveillance framework, ensuring that such information is publicly accessible to Serbian citizens.

Recommendations

For Serbian Competent Authorities

- The Ministry of Health should expedite the adoption of a new *Rulebook on Materials and Articles Intended to Come into Contact with Food*, harmonised with EU legislation and national regulations based on scientific principles, Serbian, European, and international standards, guidelines, and recommendations, to the extent necessary to protect the life and health of Serbian citizens and the environment.
- Upon adoption of the new Rulebook, the Ministry of Health should establish an appropriate mechanism for the regular updating of the Rulebook to ensure prompt alignment with amendments to EU regulations.
- Strengthening inspection controls for all food contact materials, including the oversight system for products sold online.
- Harmonise testing procedures and methodologies across all authorised laboratories operating within the Republic of Serbia.
- Assign the monitoring and testing of food contact materials, including ceramic mugs, exclusively to Institutes and Institutes of Public Health that possess accredited methods, qualified personnel, and proven experience in such testing.
- Improve coordination between sanitary and market inspectors to ensure timely exchange of information on non-compliant products and the publication of information on unsafe products and corrective actions in the NEPRO rapid alert system of the Republic of Serbia, so that such information is publicly accessible to all citizens.

For Companies

- Increase awareness among economic operators (manufacturers, importers, distributors, and retailers) of their obligation and responsibility to place only health-safe and compliant products on the market, supported by appropriate laboratory testing documentation.
- All economic operators should regularly monitor upcoming and published amendments to regulations, ensuring timely adjustments to requirements imposed on manufacturers (in the case of imports) or to their own production processes (in the case of domestic manufacturing).
- Manufacturers of ceramic mugs should be thoroughly familiar with the composition of all materials used in production. They should apply Good Manufacturing Practice (GMP) principles and follow all precautionary measures listed in the Safety Data Sheets for the raw materials they use.
- Finished products must not be placed on the market before laboratory testing is completed and confirmation is obtained that the mugs are safe for use and compliant with regulations. Ceramic mugs with different decorations represent distinct products and should therefore be tested separately.
- A manufacturer planning to export to the EU must conduct testing in accordance with EU-relevant regulations and methods, in accredited laboratories authorised to perform such testing, and only after confirmation of compliance should export be organised.

- Lead- and cadmium-based pigments should be avoided and replaced with safer alternatives.
- Strict adherence to all precautionary measures stated in the Safety Data Sheets for each chemical (raw material) must be ensured throughout the entire production process, including storage and waste disposal, with particular attention to the protection of workers' health.
- Economic operators must bear in mind that they are legally obliged to inform consumers clearly and effectively about the reasons for product recalls, and, if necessary, to request the return of products already supplied if other measures cannot ensure a high level of health protection.They must also notify the Ministry of Health and the public in writing of any non-compliant or unsafe products found on the market that have reached consumers, along with the measures taken.

For Consumers

- Avoid ceramic mugs decorated with intense colours on the inner surface or on the outer surface near the rim.
- Before purchasing mugs from popular online platforms or manufacturers selling exclusively online, be aware that such products often bypass official safety controls.[24]
- Use mugs in accordance with their intended purpose and the manufacturer's instructions. Read the label carefully and follow all the recommendations provided.
- Do not use damaged mugs or those that have changed colour or surface characteristics after several washings or uses.
- Buy only what you truly need — avoid excessive purchasing driven by holiday-themed designs or marketing trends.
- Stay informed about how to live safely with chemicals in everyday life.
- Purchase from reputable manufacturers, as they have a strong interest in maintaining high product quality and safety standards to protect their reputation and consumer trust.
- Support small domestic producers, including artisanal workshops, by purchasing their products — but request proof that the product has been tested and confirmed safe.

24 EU e-commerce plans: consumer groups call for urgent and ambitious action

Annex I – Table of Migration of Lead and Cadmium in the Tested Articles

Sample code	Mug description	Tested part of the sample	Results of element migration testing		Compliant with Serbian regulation (YES/NO)
			Pb	Cd	
ALH-1A	Blue mug featuring an inscription and Belgrade symbols	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	0,005 mg/dm² (0,03 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-2A	Mug with a black base and the inscription "Belgrade" in various languages	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	0,02 mg/dm² (0,12 mg/L)	0,004 mg/dm² (0,024 mg/L)	YES
ALH-3A	Speckled greyish-green mug with an uneven brown rim and a smooth surface	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	0,007 mg/dm² (0,04 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-4A	Solid-colored mug in pastel blue-green with a brown rim	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-5A	Mug with a design inspired by Gustav Klimt's painting "The Kiss"	Inner surface of the mug	<0,02 mg/l	<0,004 mg/l	YES
		Outer surface of the mug, 20 mm from the upper rim	0,081 mg/dm² (0,49 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-6A	Large red mug with the inscription "MUM"	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/Lmg/l)	YES

ALH-7A	Yellow mug with a gold rim and crown-shaped decoration, uneven surface	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	0,011 mg/dm² (0,07 mg/L)	0,001 mg/dm² (0,006 mg/L)	YES
ALH-8A	Small matte red mug with the inscription Gryffindor TM	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	0,004 mg/dm² (0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-9A	Red handmade decorative mug with gold details	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-10A	Pink-purple decorative mug with gold details	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-11A	Yellow mug with a painted artwork design and a yellow interior	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-12A	Smooth white mug with blue, yellow, and green lines along the rim where the lips touch	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	0,003 mg/dm² (0,02 mg/Ll)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-13A	Slightly rough-textured mug with a splattered red design intensified along the rim and a red interior	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES

ALH-14A	Souvenir mug – JOLY, decorated with letters and symbols of Serbia on the outside and inside	Inner surface of the mug	<0,02 mg/L	**0,336±0,047 mg/L**	NO
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	0,004 mg/dm² (0,024 mg/L)	YES
ALH-15A	Pink mug covered in glitter, white on the inside	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-16A	Mug shaped and colored like a strawberry	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-17A	Blue mug with orange polka dots	Inner surface of the mug	<0,02 mg/Lmg/l	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-18A	Orange and white mug with polka dots	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-19A	Orange mug with pink flowers and an inscription "She believed she could, so she did"	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-20A	Blue mug with white daisies and an inscription "What is yours will find you"	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES

ALH-21A	Blue mug with white raised dots and an uneven surface	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-22A	Red boho-style mug with white flowers on the outside and a colourful interior	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-23A	Yellow boho-style mug with white flowers on the outside and a colourful interior	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-24A	Orange boho-style mug with a green handle and base, white and multicoloured on the inside	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-25A	Dark blue-green boho-style mug with white flowers, colourful on the inside	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES
ALH-26A	Yellow coffee cup with navy blue fish, part of a set of six cups	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	**13,1 mg/dm² 78,6 mg/L)**	**0,04 mg/dm² (0,24 ± 0,03 mg/L)**	NO
ALH-27A	Coffee cup with a red and black pattern, part of a set of six cups	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	**2,01 mg/dm² 12,06 mg/L)**	**0,04 mg/dm² (0,24 ± 0,03 mg/L)**	NO

ALH-28A	Coffee cup with a red, blue, and black pattern, part of a set of six cups	Inner surface of the mug	<0,02mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	**4,3 mg/dm² 25,8 mg/L)**	0,016 mg/dm² (0,096± 0,013 mg/L)	NO
ALH-29A	Coffee cup with a yellow, blue, and black pattern, part of a set of six cups	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	**10,1 mg/dm² 60,6 mg/L)**	0,004 mg/dm² (0,012 mg/L)	NO
ALH-30A	Navy blue bo-ho-style ceramic mug with white flowers, colourful on the inside	Inner surface of the mug	<0,02 mg/L	<0,004 mg/L	YES
		Outer surface of the mug, 20 mm from the upper rim	<0,003 mg/dm² (<0,02 mg/L)	<0,001 mg/dm² (<0,004 mg/L)	YES

Annex II – Tested Articles

ALH-1A

ALH-2A

ALH-3A

ALH-4A

ALH-5A

ALH-6A

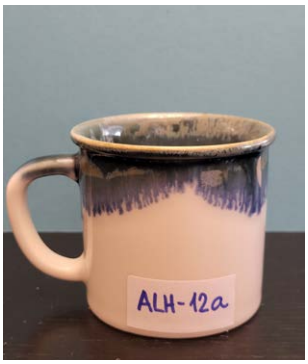
ALH-7A

ALH-8A

ALH-9A

ALH-10A

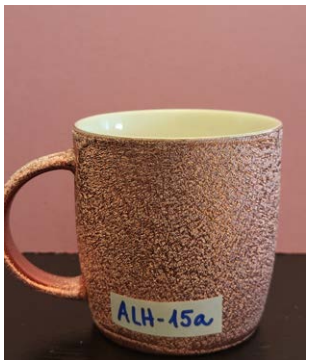
ALH-11A



ALH-12A

ALH-13A

ALH-14A

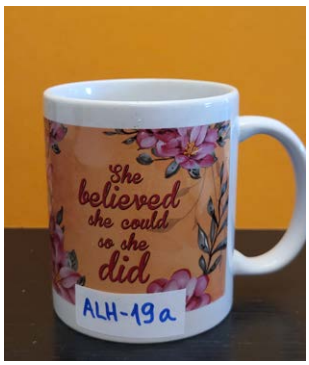


ALH-15A

ALH-16A

ALH-17A

ALH-18A



ALH-19A

ALH-20A

ALH-21A

ALH-22A

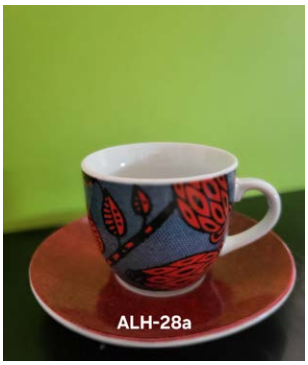

ALH-23A

ALH-24A

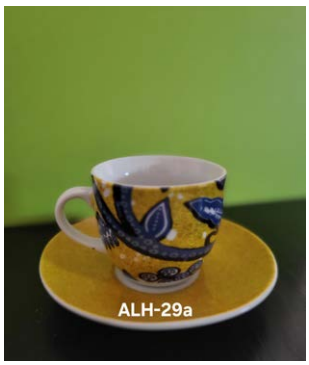

ALH-25A

ALH-26A

ALH-27A



ALH-28A



ALH-29A


ALH-30A

Annex III – Tabular Overview from the EU RASSF Portal of Notifications Regarding the Migration of Lead and Cadmium from Ceramic Tableware from 2021 to September 2025

	Reference	Subject	Date	Origin	Notifying	Decision	Classification	Results	Specific Migration Level
2021 (1 notification regarding lead migration, a total of 269 notifications on Food Contact Materials)[25]									
1.	2021.7142	ceramic children's mug from China	24 DEC 2021	China	Finland	border rejection notification	Serious	Migration of lead (0.066 - 0.087 mg/dm²)	0,005 mg/dm² (Finland SML)
2022 (3 notifications regarding lead migration, a total of 219 notifications on Food Contact Materials)[26]									
1.	2022.0086	Migration of lead and cobalt from ceramic plates from China	5 JAN 2022	China	Germany	alert notification	Serious	Lead - heavy metals: 2,3 ± 0,7 mg/dm²	n/a
2.	2022.4294	Lead migration from ceramic plate from China	22 JUL 2022	China	Poland	alert notification	Serious	Lead – migration: 1,5 ± 0,4 mg/dm²	n/a
3	2022.6387	Migration of Pb 22.3 mg/L, 18.0 mg/L, 14.4 mg/L from ceramic bowles from Uzbekistan	2 NOV 2022	Uzbekistan	Latvia	information notification for attention	Serious	Lead – migration: 22.3 mg/L 14.4 mg/L 18.0 mg/L	4.0 mg/L

25 2021 Annual Report https://food.ec.europa.eu/document/download/e8b14245-1f30-4f2b-bf5c-5e70e525e753_en?filename=acn_annual-report_2021-final.pdf
26 2022 Annual Report https://food.ec.europa.eu/document/download/499ffcf1-6c99-43ec-8905-5ff3e812eeb2_en?filename=acn_annual-report_2022.pdf

	Reference	Subject	Date	Origin	Notifying	Decision	Classification	Results	Specific Migration Level
2023 (1 notification regarding lead migration, a total of 193 notifications on Food Contact Materials)[27]									
1.	2023.3797	Migration of lead in ceramic plate from Germany	7 JUN 2023	Germany	Austria	alert notification	Serious	Lead – migration 0.1655 to 0.21618 mg/dm²	0.8 mg/dm²
2024 (3 notifications regarding lead migration, a total of 257 notifications on Food Contact Materials)[28]									
1.	2024.4040	Migration of lead from the lip rim of ceramic mug from China.	24 MAY 2024	China	Finland	border rejection notification	Serious	Lead - migration 0,81 mg/dm²	0,50 mg/dm² (Finland SML)
2	2024.5254	Lead-permeability of hand-made ceramic graters from Spain	9 JUL 2024	Spain	Germany	alert notification		Lead - migration 7,7 ± 2,7 mg/dm2 / 13,3 ± 4,7 mg/dm2 / 9,4 ± 3,3 mg/dm²	0.8 mg/dm²
3.	2024.6766	Lead and cobalt in ceramic plate from China	9 SEP 2024	China	France	information notification for attention	Serious	Lead - migration 6,5 mg/L	1,5 mg/L (France SML)
2025 (1 notification regarding lead migration until September 2025)									
1.	2025.2726	Lead poisoning caused by the use of a ceramic carafe	11 APR 2025	Greece	France	alert notification/	Serious	Lead - migration 1444,73 mg/L	n/a

27 2023 Annual Report https://food.ec.europa.eu/document/download/911d49f2-b3ef-4752-8ea3-5f20dbbe9945_en?filename=acn_annual-report_2023.pdf
28 2024 Annual Report https://food.ec.europa.eu/document/download/a47b9d6a-9b47-4b57-a1ca-35e5bbfa837f_en?filename=acn_annual-report_2024.pdf

This document has been produced with the financial assistance of the Transition Promotion Programme of the Ministry of Foreign Affairs of the Czech Republic. This work is part of the project "Educating the Young Generation for an Environmentally Responsible Serbia", implemented by Arnika – Toxics and Waste Programme and Safer Chemicals Alternative (ALHem), under the Transition Promotion Program.