

L.R. Babchuk

Food's Ceramic Pot Source of Cadmium's Intoxication the Body Human

SHEE "Ivano-Frankivsk National Medical University", st. Galytska, 2., Ivano-Frankivsk, 76000, Ukraine, e-mail: telure@ukr.net

Heavy metal cadmium is classified to the World Health Organization to the most hazardous substances for human health. The aim is to study the food pottery as an object that can be a source of cadmium in the human body. The various kinds of food ceramic products, which may contain pigments based on cadmium compounds, are considered. It was found that the cadmium sulfide can be an integral part of underglaze or onglaze ceramic paints, glazes, ceramic mass and a chandelier. The most intense release of cadmium comes with glaze and paint ceramic mass and carries the greatest risk in respect of this heavy metal pollution of the human body. Process cadmium poisoning human body compounds can last for years, cadmium tends to accumulate in the body for a long time. Therefore, the use of externally beautiful, but the harmful chemical composition, color of ceramic tableware harmful to human health.

Key words: ceramic tableware, heavy metal cadmium, cadmium sulfide, ceramic colors, glazes, chandelier.

Article acted received 07.05.2017; accepted for publication 05.09.2017.

Introduction

The unfavorable ecological situation in recent decades is the cause of a significant toxic and chemical load on the biosphere, which leads to the emergence of new forms of human pathology.

A special place among toxicants is occupied by heavy metals. The most dangerous are lead and cadmium. A food ceramic dish can become a source of cadmium in the human body.

Heavy metal cadmium is attributed by the World Health Organization to the substances most dangerous to human health [1, p.135].

Cadmium reduces the activity of a number of enzymes, affects the liver, kidneys, pancreas and is accumulated in these organs. Target organs with intoxication with cadmium are kidneys, bone marrow, liver, partly spleen and other organs.

In case of chronic intoxication, cadmium is a defeat of the kidneys (necrosis of the epithelial cells, retardation of filtration in the renal canal, reduction of reabsorption, the presence of cadmium in the urine, increased excretion of urine of beta-2-microglobulin, protein-bound retinol. Violation of the processes of reabsorption leads to defeat of the bone system (increased bone fragility, multiple

fractures of the limbs).

By the average content in the human body, cadmium is counted as micronutrients. This chemical element is virtually absent in the body of the newborn, and with age it is accumulated by the human body and may exceed the permissible norm. Studies conducted in recent years, have revealed inconspicuous facts of the presence of children in the body of excess biological tolerance levels of a number of toxic metals, among which a significant place is the accumulation of cadmium [2 p. 26; 3, p. 23].

Cadmium heavy metal salts have an adverse effect on immunity. Cadmium has carcinogenic properties and increases the risk of developing atherosclerosis and hypertension. Chronic cadmium poisoning destroys the liver, causes severe back and leg pain, leads to bone fractures, causes kidney damage and leads to death.

As a result of the research, three main ways of cadmium in the human body have been identified: air, water, and food [4, p. 15; 5, p. 19].

One of the main ways of getting cadmium in the human body is through the intestinal and gastrointestinal tract during meals. Cadmium compounds are often found in foods through the atmosphere and the soil. However, these dangerous compounds can be found in food and during their movement from agricultural and food businesses to the final consumer and in the process of

cooking or consuming food by a person [6, p. 16; 7].

I. Main part

The purpose of this work is to study food ceramic ware, as an object that can become the source of the receipt of heavy metal cadmium in the human body. The main task of the study is to identify the elements of ceramic products used as dishes for eating or storing it and which may include compounds of toxic metal cadmium.

The use of inorganic pigments - metal compounds for the manufacture and design of ceramic products has been known since ancient times. Various types of food ceramic products, which are subjects of daily use by many people and may contain pigment based on cadmium compounds, were considered.

Color food ceramic ware of various kinds is presented on the Ukrainian market. Because of the attraction to the aesthetics, the person intuitively wants to choose a ceramic product of bright color or with a beautiful pattern. Not always very beautiful outside or bright ceramic dishes are safe to use and compatible with food.

Cadmium sulfide and cadmium selenide are used respectively as yellow and red dyes in the manufacture of ceramic paints. Ceramic paint - this mineral pigments that paint based on mineral dyes - painted oxides or metal salts. The color of ceramic pigments is formed due to the compounds of chemical elements due to light absorption due to d-d transitions of electrons or due to charge transfer. The color of ceramic pigments is formed due to the compounds of chemical elements due to light absorption due to d-d transitions of electrons or due to charge transfer.

To obtain bright shades of yellow, as a component of ceramic paints, use the colored salts of cadmium sulphide. To obtain ceramic dishes or paintings in colorful shades of red - from orange to cherry-red can be used to add selenium to cadmium sulfide (Table 1).

Ceramic paints on the basis of cadmium sulfide or with the addition of selenium are used for coloring of ceramic products, manufacturing of glazes ceramic products. For better melting of cadmium sulfide to the water or to the main ceramic material, it is mixed with grades of special fusible glass (fluxes) or with appropriate glazes, feldspar, kaolin.

Ceramic paints on the nature of application are underlay paints and overlay paints. Overlay paints are applied to the firing ceramic product, prepoliti glazes, with subsequent fixing them on this product with decorative firing. Underlay ceramic paints are applied to a non-impermeable ceramic product, which, after drying, is covered with glazes and firing. Overlay paints represent a fine disperse mixture of pigments with fluxes. Fluxes - a mixture of colorless mineral oxides and salts of silicon, sodium, potassium, boron. Fluxes for overlay paints are special fusible glass. The purpose of fluxes is to fix ceramic paints on the glazed surface of the product, as well as to give them the appropriate luster.

Table 1

Colors of cadmium pigments and temperature of their use

| Pigment color | Chemical element composition of pigment | Temperature mode of using pigment |
|---------------|---|-----------------------------------|
| yellow | Cd-S-Zn | 850°C |
| orange | Cd-S-Se-Zn | 850°C |
| cherry red | Cd-S-Se | 850°C |
| bright red | Cd-S-Se-Al | 850°C |
| intense red | Cd-S-Se | 850°C |
| dark red | Cd-S-Se-Zr-Si | 1000°C |

Mixing fluxes with pigments allows you to get colored melt when heated, practically analogs of colored glass if they are transparent or smalt if they are opaque. Mixing fluxes with pigments allows you to get colored melt when heated, practically analogs of colored glass if they are transparent or smalt if they are opaque. Conventional ceramic paints are obtained by grinding in ball mills specially cooled by fusion of mineral components - frits. The dispersion of the grinding (average amount of paint particles) is 4 - 8 microns, which allows the use of ceramic paints for all the methods used today.

The modern variety of food decorated ceramic dishes can be achieved through screen printing, where the ceramic paint is used either as a dry powder form or as a paste. The same forms of ceramic paint can print decals, spray, draw, make stamps and use them for hand-painted.

Overlay paints in comparison with the sublime are less shiny and erased when long service. In the process of using a ceramic product painted with ceramic paint on the basis of cadmium compounds, heavy metal cadmium is easily and systematically transferred to the human body. Underlay paints, which are not directly exposed to atmospheric and other agents (being protected by a layer of irrigation), are relatively durable. But in the process of exploitation, with the advent of micro cracks in the glazes of release of cadmium will be easy and continuous.

The nature of the application of paints (underlay, overlay, interlayer) depends on the ratio of pigment-flux. In the high-temperature region of overlay decoration in paints there is more pigment, and hence cadmium compounds and less flux (approximate ratio - about 80% pigment and about 20% flux). This decoration has the largest share of cadmium.

For interlayer, overlay paints, this ratio is consistently varied in such a way that the proportion of pigment decreases. Paints for thin-walled dishes, on the contrary, contain about 80% flux and about 20% pigment. Accordingly, the more pigment and less flux, the higher the temperature of the paint and its coating ability. Pigments one scope may be mixed together.

Number of pigment introduced into fluxes, glazes, ceramic masses, etc. depends on the type of ceramic products and artistic intention producer.

Ceramic paints are combined in the collection for the convenience of decoration. Using paint collections allows you to burn a multi-colored product into one firing. For intermediate shades, ceramic paints are mixed. From the point of view of mixing ceramic paints are divided into two groups: cadmium (red, orange, warm yellow tones) and without cadmium (all other colors). Inside each of the paint groups are mixed universally, that is, in any ratio. This is because the cadmium paint is less flame resistant. Mixing of colors between the groups further reduces the fire resistance of the mixture. Therefore, the specific ratios in the mixing depend on the temperature of the firing. Mixing cadmium paints with without cadmium in equal proportions, as a rule, leads to the formation of a dirty-gray tint, but in other proportions gives a large gamut of colors from all shades of green to vivid shades of violet.

As it was investigated, a ceramic paint of the following colors could be harmless: cream, white, gray-blue, black and blue. All other colors, especially bright, may contain cadmium compounds [8, p.16].

The use of cadmium paints and / or their mixtures is possible only with a dense overlap. Historically, it was considered that due to reduced fire resistance, the use of cadmium paints in the high-temperature (over 950 ° C) area is impossible (Table 1). However, this problem was solved with the appearance of so-called "included" pigments about 50 years ago. "Included" is called a coloring pigment, enclosed in a transparent shell of zirconium oxide. This allowed the use of cadmium pigments at temperatures up to 1350 ° C in the interflow and underlying areas of decoration, as well as in the coloring of ceramic masses. Thus, many manufacturers of ceramic products have more opportunities to create new collections and actively apply cadmium ceramic paints.

In addition to the bright decor, colored glazes, the food ceramic product can be decorated with a chandelier. Chandeliers are called metal solutions or their compounds in essential oils. The chandelier applied to the surface of the ceramic products surface forms a thin film with a characteristic metallic shine and a mother-of-pearl shade. The metallic glare of the chandelier is the result of the diffusion of the smallest particles of the metal into the surface layer of softened water. The difference in the refractive index of light and the surface

of the chandelier leads to the decomposition of light rays. Among all kinds of lusters are distinguished and colorless (bismuth, alumina, lead, zinc) and painted (iron, chromium, cobalt, copper, cadmium) and metallic (with the contents of precious metals - silver, gold, platinum). Therefore, chandeliers can also be a source of cadmium intoxication of the human body.

The detection of cadmium in ceramic materials was carried out by the method of accelerated allocation [9], according to the experimental method and atomic absorption spectrometry method using a muffle furnace and a spectrophotometer C-115PK, the wavelength Cd is 228.8 nm, the sensitivity of the device is not less than 0.05 mg / l of cadmium.

II. Conclusions

Different kinds of food ceramic dishes have been investigated. All products may be the source of cadmium intoxication of the human body in the manufacture of which were used cadmium compounds. These are ceramic products made with the use of overlay paints on the basis of mineral pigment of cadmium sulfide, cadmium sulfide painted ceramic masses, underlay paints, irons consisting of cadmium compounds and chandeliers, components of which are compounds containing chemical element cadmium.

It was found that the most intense release of cadmium from the surface of the ceramic product comes from the overlay paint and ceramic mass, which carries the greatest risk of contamination by this heavy metal of the human body. The process of poisoning can last for years, cadmium compounds have the property of accumulation in the body for a long time. Therefore, the use of a beautiful outside of a colored ceramic dish, but hazardous to the chemical composition, can be dangerous to the health of a person who uses such dishes for a nutritional purpose.

Subsequent studies will focus on determining the proportion of ceramic products manufactured in Ukraine and imported origin that endangers the health of Ukrainian citizens through the content of heavy metal cadmium and the identification of the most optimal methods for their identification.

Babchuk L.R. - Assistant Professor, Department of Biological and Medical Chemistry G.O. Babenko.

- [1]. International program on chemical safety and environmental health criteria 134 Cadmium (WHO, Geneva, 1992).
- [2]. SV Zalavin, AV Rocky, SV Efimov, EA, Vaskina, Microelements in medicine, 8 (4), 25 (2007).
- [3]. K. Krupka, S. Puczkowski. Laboratorium pierwiastkow nieznachney ilosci (Lodz, 2004).
- [4]. L.R. Babchuk, Scientific Works SWorld. 30 (3), 13 (2014)
- [5]. S.M Babchuk, L. R. Babchuk, East-European Journal of Advanced Technologies, 62 (2/10), 18 (2013).
- [6]. S. M. Babchuk, L. R. Babchuk, East-European Journal of Advanced Technologies, 60 (6/2), 14 (2012).
- [7]. L.R. Babchuk, Tenth International Scientific and Practical Conference "Development of Scientific Research - 2014" (InterGraphics, Poltava, 2014), p. 67
- [8]. L.R. Babchuk, Scientific and Practical Conference with International Participation "Babenko Readings" (IFNMU, Ivano-Frankivsk, 2013), p. 16
- [9]. S.M Babchuk, L. R. Babchuk Patent for Utility Model No. 83550 "Method for the allocation of cadmium from ceramic dishes", State Register of Patents of Ukraine for utility models from 10.09.2013.

Л.Р. Бабчук

Харчовий керамічний посуд як джерело кадмієвої інтоксикації людського організму

ДВНЗ «Івано-Франківський національний медичний університет», вул. Галицька, 2, м. Івано-Франківськ, 76000, Україна, e-mail: telure@ukr.net

Важкий метал кадмій віднесений Всесвітньою організацією охорони здоров'я до найбільш небезпечних речовин для здоров'я людини. Одним з основних шляхів надходження кадмію в людський організм є потрапляння через кишково-шлунковий тракт під час прийому їжі.

Метою роботи є дослідження харчового керамічного посуду як об'єкта, що може стати джерелом надходження кадмію в людський організм. Під час досліджень розглянуто різні види харчових керамічних виробів, що можуть містити пігменти на основі сполук кадмію.

В результаті проведених досліджень визначено елементи харчового керамічного посуду, які можуть бути джерелом надходження в організм людини токсичного металу кадмію. Встановлено, що кадмій сульфід може бути складовою частиною підполивної чи надполивної керамічної фарби, поливи, керамічної маси та люстру.

Виявлено, що найінтенсивніше вивільнення кадмію з поверхні керамічного виробу відбувається з надполивної фарби та керамічної маси, що й несе найбільшу небезпеку щодо забруднення цим важким металом людського організму. Процес отруєння людського організму сполуками кадмію може тривати роками, кадмій має властивість накопичуватися в організмі протягом тривалого часу. Тому використання зовні красивого, але шкідливого по хімічному складу, кольорового керамічного посуду небезпечно для здоров'я людини.

Ключові слова: керамічний посуд, важкий метал кадмій, кадмій сульфід, керамічні фарби, полива, люстр.