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CONTAMINATION OF COSMETICS WITH TOXIC ELEMENTS AND RISK ASSESSMENT FOR CONSUMERS' HEALTH

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ABSTRACT. The aim of the Research. *To study the content of toxic elements (lead, arsenic and mercury) in decorative cosmetics.*

Methods and Materials. *The study included lipsticks, mascara, children's decorative cosmetics from domestic and foreign manufacturers (Ukraine, Finland, France, Latvia, Japan) and pigments used in manufacturing. The content of toxic elements was determined using inductively couple plasma atomic emission spectrometry on JCPE-9820-2015 device. Advanced mathematical and statistical methods were applied to analyze the findings of the study.*

Results and Discussion. *The findings of the study indicate that decorative cosmetics products in the Ukrainian market may contain lead and arsenic concentration resulting in undesirable health outcomes.*

Conclusions*. The study on toxic elements contents in decorative cosmetics products proves the necessity for these products mandatory control by the given indicators. Thorough sanitary and chemical control over their production and selling will prevent access of low quality and hazardous to human health cosmetic products to the Ukrainian market.*

Key Words: *decorative cosmetics, hazard, lead, arsenic and mercury concentration.*

Introduction. The use of both decorative and care cosmetics dates from ancient Egypt and Greece times and exists as long as the mankind lives. The word cosmetics derives from Greek meaning "technique of dress and ornament". Evidently these techniques have been changing over time. Nowadays they are various substances used to enhance the appearance or smell of human body: creams, perfumes, lotions, lipsticks, dyes, gels, oils and bath salts. They include decorative cosmetics products and personal care cosmetics.

Over its history of application, cosmetics, decorative in particular, have not always been useful and harmless. It is known that ancient Greeks and Romans used cosmetics containing not only natural ingredients but also such poisonous substances as mercury and lead. They were considered useful for skin that time.

In terms of modern cosmetics contents, they totally differ from the ancient types. As scientific research findings indicate, there are new reasons for legitimate concerns, though. They refer to the fact that in the second half of the 20th century cosmetologists began to use chemical compounds which unlike the reliable natural ingredients may cause remote undesirable outcomes due to their long-term application and have been affecting the consumer's health [1, 2, 3].

Due to the extension of cosmetic products range by domestic and foreign manufacturers the product safety issues are becoming more and more relevant.

To our mind, cosmetic products safety investigations must focus on cosmetics comprehensive analysis aimed at hazardous factors identification and the assessment of their level, including through defining the cosmetic products compliance with the ongoing sanitary norms and regulations of Ukraine and international norms. In case of the absence of relevant regulations, it is necessary to justify medical requirements for the products safety for human health and life through their expert assessment.

The most extensively used decorative cosmetics products are powders, lipsticks, mascaras, brow mascaras. Their safety assessment in Ukraine is performed according to State sanitary rules and norms №2.2.9.027-99 on sanitary rules and regulations on cosmetics products safety, State sanitary rules and norms and Regulation (EC) No 1223/2009 of the European

Parliament and of the Council of 30 November 2009 on cosmetic products [5, 6]. These documents imply research into potential risks of these products application by their organoleptic, microbiological, sanitary and chemical and toxicological indicators. We are of the opinion that one of the most significant safety indicators is the presence of toxic metals in cosmetic products, namely arsenic, mercury and lead, which are forbidden under above-mentioned documents.

It is important to note that, unlike international regulations, the regulations of the Republic of Belarus and those of the Russian Federation do not forbid the presence of heavy metals in decorative cosmetics. Thus, the concentration of toxic metals in these products and raw materials for their manufacturing mustn't exceed 5,0 mg/kg for arsenic, 1,0 mg/kg for mercury and 5,0 mg/kg for lead. More severe requirements are established for children's and intimate cosmetics, for lips and eyes, namely at the level of not higher than 2,0 mg/kg for arsenic, 0,5 mg/kg for mercury and 2,0 mg/kg for lead [6 – 9].

It is known that arsenic and its compounds affect central, autonomic and peripheral nervous systems, digestive system, liver and kidneys. The International agency for research on cancer regards it as the first group of carcinogens. The majority of arsenic compounds, arsine in particular, are classified as hemolytic poison.

Mercury and its compounds are highly toxic substances which can accumulate in the human body and result in metabolic disorders of ascorbic acid, pyridoxine, calcium, zinc, copper, proteins, cysteine, tocopherols, iron, magnesium and selenium.

Lead is one of the most well-known toxic metals for human health. Its high biological hazards are manifested in its high toxicity and ability to accumulate in the human body. Lead is a highly cumulative substance with polytropic actions and is especially dangerous for children's health and mental development. Lead poisoning affects hematopoietic organs, kidneys, cardiovascular and central nervous systems. Hematopoietic system in children is the most sensitive to lead poisoning [10-15].

It is necessary to note that, according to research findings, the mean and median usage of lipstick by women aged 19-65, who regularly use the product of interest, is from 13 mg to 24 mg per day. Assuming that a woman puts on a lipstick during 55 years, she ingests from 320 to 482 g of lipstick during her lifetime. The studies show that even this small amount can be hazardous for health – depending on the contents. Lipstick mainly contains wax, fats, oils and chemicals which provide color, taste and resistance. The USA researchers found the presence of lead, aluminum, cadmium, cobalt, chromium, manganum, nickel and titanium in different brands of lipstick. The compared amount of usage per day with the level of toxic ingredients concentration found in tested lipstick brands suggests their potential health risk. Thus, in such brands as Dior, Maybelline, Max Factor and Oriflame lead was detected at levels 3,19, 3,70, 4,23 and 4,37 mg/kg respectively. If a woman digest on average 8 g of lipstick per year, she intakes 0,04 mg of lead. It is not a big amount but this substance is able to accumulate in the body [15].

Aim. To study toxic elements (lead, arsenic and mercury) concentration in decorative cosmetic products.

Methods and Materials. The object of study was lipsticks from domestic and foreign manufacturers (Ukraine, Finland, France, Latvia, Japan) and pigments used in manufacturing.

Results and Discussion. The content of toxic elements was determined using inductively couple plasma atomic emission spectrometry on JCPE-9820-2015 device. The lowest significance levels are the following: < 0,1 for lead, < 0,04 for arsenic, < 0,012 for mercury. Advanced mathematical and statistical methods were applied to analyze the findings of the study [17].

The research of decorative cosmetics – lipsticks from domestic and foreign manufacturers (Ukraine, Finland, France, Latvia, Japan) and pigments used in manufacturing – was conducted.

The research results of toxic metals concentration determination in decorative cosmetic products are shown in Tables 1 and 2.

The results in Tables 1 and 2 show toxic lead and arsenic elements concentration at significant levels (Pb – from 0,75 to 3,35 mg/kg, As – from 0,05 to 1,8 mg/kg), mercury was absent at the sensitivity of the measurement level in the analyzed samples (< 0,012).

The obtained results prove that the analyzed samples of decorative cosmetics for both adults and children contain toxic elements (lead and arsenic) at levels hazardous for human health. It was also found that the toxic metals presence in decorative cosmetic products is caused by pigments which they contain.

Table 1

Toxic metals concentration in decorative cosmetic products

Product name	Metal concentration, mg/kg			Specification requirements
	Pb	As	Hg	
Pearl stick lipstick (Ukraine)	< 0,3	0,15±0,05	< 0,012	absent
Lipstick (Ukraine)	3,35±0,3	1,8±0,2	< 0,012	absent
Lipstick (Finland)	0,54±0,3	0,05±0,01	< 0,012	absent
Lipstick (France)	< 0,1	< 0,04	< 0,012	absent
Lipstick (Latvia)	< 0,1	< 0,04	< 0,012	absent
Lipstick (Japan)	0,75±0,3	< 0,04	< 0,012	absent
Lipstick for children (China)	0,68±0,2	0,14±0,1	< 0,012	absent

Table 2

Toxic metals concentration in raw materials

Pigments	Concentration, mg/kg			Specification requirements
	Pb	As	Hg	
Carbon black pigment	< 0,1	0,35±0,2	< 0,012	absent
Light-resistant red	0,18±0,2	0,19±0,1	< 0,012	absent
Light-resistant orange	0,42±0,3	0,20±0,1	< 0,012	absent

After conducting the investigation and defining the causes of toxic metals presence in domestic products, namely of lead and arsenic in raw materials, the list of ingredients in lipstick was changed (pigments were replaced). New samples investigation results are shown in Table 3.

The findings in Table 3 show that toxic elements are absent after the changes in ingredients have been made.

Thus, our research contributed to developing nontoxic ingredients and prevention of hazardous for consumers' health products to the Ukrainian market.

Conclusions. The research findings show that decorative cosmetics in the Ukrainian market may contain lead and arsenic in concentrations hazardous for human health. The research on toxic elements concentration detection in decorative cosmetic products proves the necessity for these products mandatory control by the given indicators. Thorough sanitary and chemical control over their production and selling will prevent access of low quality and hazardous to human health cosmetic products to the Ukrainian market.

Table 3

Toxic metals concentration in domestic products after changing the ingredients

Lipstick (Ukraine)	< 0,1	< 0,04	< 0,012	absent
Pearl stick lipstick (Ukraine)	< 0,3	0,15±0,05	< 0,012	absent

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ЗАБРУДНЕННЯ КОСМЕТИЧНОЇ ПРОДУКЦІЇ ТОКСИЧНИМИ ЕЛЕМЕНТАМИ ТА ОЦІНКА МОЖЛИВИХ РИЗИКІВ ДЛЯ ЗДОРОВ`Я СПОЖИВАЧІВ

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РЕЗЮМЕ. Мета роботи. *Вивчити вміст токсичних елементів (свинцю, арсену та ртуті) у виробах декоративної косметики.*

Матеріали та методи. *Об'єктом досліджень були губні помади, туші для вій, дитяча декоративна косметика вітчизняного та закордонного виробництва (Україна, Фінляндія, Франція, Латвія, Японія) та пігменти, які були застосовані для їхнього виготовлення.*

Визначення вмісту токсичних елементів проводили методом атомно-емісійної спектрометрії з індуктивно-зв'язаною плазмою на приладі JCPE-9820-2015. Для обробки результатів дослідження були використані сучасні математично-статистичні методи.

Результати. *Результати досліджень свідчать, що декоративна косметична продукція, присутня на ринку України, може містити у своєму складі свинець та арсен у концентраціях, які є небезпечними для здоров'я людини.*

Висновки. *Проведені дослідження по визначенню вмісту токсичних елементів у косметичних виробах декоративної косметики вказують на необхідність обов'язкового контролю даного виду продукції за вказаними показниками. Ретельний санітарно-хімічний контроль за їхнім виробництвом та реалізацією сприятиме попередженню доступу неякісної та небезпечної для здоров'я людини косметичної продукції на ринок України.*
Ключові слова: *декоративна косметика, небезпека, вміст свинцю, арсену та ртуті.*

ЗАГРЯЗНЕНИЕ КОСМЕТИЧЕСКОЙ ПРОДУКЦИИ ТОКСИЧНЫМИ ЭЛЕМЕНТАМИ И ОЦЕНКА ВОЗМОЖНЫХ РИСКОВ ДЛЯ ЗДОРОВЬЯ ПОТРЕБИТЕЛЕЙ

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РЕЗЮМЕ. Цель работы. *Определение содержания токсических элементов (свинца, мышьяка и ртути) в изделиях декоративной косметики.*

Материалы и методы. *Объектом исследований были губные помады, детская декоративная косметика отечественного и зарубежного производителя (Украина, Финляндия, Франция, Латвия, Япония), а также пигменты, которые были использованы для их изготовления.*

Определение содержания токсических элементов проводили методом атомно-эмиссионной спектрометрии с индуктивно-связанной плазмой на приборе JCPE-9820-2015. Для обработки результатов исследований были использованы современные математико-статистические методы.

Результаты*. Результаты исследований свидетельствовали, что декоративная косметическая продукция может содержать в своем составе свинец и мышьяк в концентрациях, которые небезопасны для здоровья человека.*

Выводы. *Проведенные исследования по определению содержания токсических элементов в изделиях декоративной косметики указывают на необходимость обязательного контроля данного вида продукции по указанным показателям. Тщательный контроль декоративной косметической продукции будет способствовать предупреждению поступления некачественной и небезопасной для здоровья человека косметической продукции на рынок Украины.*

Ключевые слова: *декоративная косметика, опасность, содержание свинца, мышьяка и ртути.*

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