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# CHEMICAL EVALUATION OF ELECTRONIC CIGGARETES

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***Key words:*** Electronic nicotine delivery devices, e-ciggaretes, chemical composition, electronic ciggaretes

***Summary:*** *The rapid growth in popularity of electronic cigarettes among the population has led to heated discussions about their benefits and harms, advantages and disadvantages. Electronic cigarettes differ in design, chemical composition and different physical properties of the aerosol produced. However, in most cases, data on the exact chemical composition of electronic cigarettes is missing.*

***Резюме:*** *Быстрый рост популярности электронных сигарет среди населения стал причиной бурных дискуссий об их пользе и вреде, преимуществах и недостатках. Электронные сигареты различаются дизайном, химическим составом и разными физическими свойствами продуцируемого аэрозоля. Однако в большинстве случаев данные о точном химическом составе электронных сигарет отсутствует.*



**Introduction.** Electronic cigarettes are electrically driven devices consisting of a battery part (usually a lithium battery) and an evaporator, where the current from the battery pack is fed to the heating element in an evaporator, which converts the charged liquid into steam. The composition of the liquid includes the following components: propylene glycol, glycerin, distilled water, flavors and nicotine. Since its invention in 2004, innovations and the development of more efficient and attractive products have been continuously introduced [1,3].

In the newest types of EC, you can simply change the spray head (resistance and wick), while maintaining the spray gun body, thereby reducing operating costs [1,3]. third-generation devices (also called “Mods”), consisting of high-capacity lithium batteries with integrated circuits, which allow vapers to change the voltage or power (power) supplied to the nebulizer. These devices can be combined either with second-generation atomizers, or with tunable atomizers, where consumers have the opportunity to prepare their own resistance and wick settings.

The rapid growth of popularity of electronic cigarettes among the population has led to heated discussions about their benefits and harms, advantages and disadvantages. Electronic cigarettes differ in design, chemical composition and different physical properties of the aerosol produced. However, in most cases, data on the exact chemical composition of electronic cigarettes is missing.

**Aim**. The aim of this article is to present a review of the scientific evidence-based primary literature review of electronic cigarettes chemical composition.

**Objective.** To review the available evidence evaluating the chemicals in refill solutions and aerosols of e-cigarettes.

**Methods.** A systematic review of the literature in the PubMed electronic database using the following keywords related to the electronic cigarettes and / or their combination (electronic cigarettes, electronic nicotine delivery devices, carcinogenic) was performed. A total of 31 publications were found, of which 20 chemical analyzes of one or a limited

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number were excluded electronic cigarettes samples, as they were discussed in a review article.

For review selected articles in English, published in refereed journals. A total of 6 articles were used in the review.

**Results and discussion.** The selected articles analyzed the chemical composition of solvents, cartridges, aerosols, and environmental emissions using electronic cigarettes.

Nicotine is the main substance of tobacco products, causing nicotine addiction. The concentration of nicotine in electronic cigarettes varies widely depending on the manufacturer. Moreover, the amount of nicotine consumed when using electronic cigarettes varies from puff to puff, and even in different electronic cigarettes of the same manufacturer. The nicotine concentration indicated on the package is often not consistent with the actual concentration measured using an electronic cigarette. The data anylysed by M.L. Goniewicz et al. (2013) [2] observed that electronic cigarettes of 15 most popular manufacturers, the nicotine content in the aerosol ranged from 0.5 to 15.4 mg per 300 puffs, which corresponded to the nicotine content in the cartridge from 21 to 85%. B.J. Westenberger [3] investigated three cartridges with the same labels and set the nicotine content from 26.8 to 43.2 μg per 100 ml of liquid (8.04–13.0 mg nicotine per 300 puffs). The content of nicotine in the exhaled aerosol also varies, which, according to the chemical composition of electronic cigarettes: 538–8770 ng / l of nicotine in indoor air compared to 5039–48 050 ng / l of nicotine when smoking conventional cigarettes [4].

Thus, given the high variability of the nicotine content in the exhaled aerosol when using electronic cigarettes, strict standardization of this indicator is necessary [5].

**Chemical substances**

The quantitative and qualitative analysis revealed a wide range of chemicals in cartridges, fillers and aerosols of electronic cigarettes, including formaldehyde, acetaldehyde, acrolein, acetone, nitrosamines, cadmium, nickel, lead, arsenic, propylene glycol, glycerin, phenols, polycyclic aromatic hydrocarbons, tobacco alkaloids et al. Many substances are also present in tobacco smoke when smoking conventional cigarettes and are known as health hazardous substances whose pathogenic effects have been proven in many clinical studies. Solvents (propylene glycol, glycerin) and humidifiers that mimic the smoke when using electronic cigarettes, when released into the environment are oxidized to form aldehydes, also present in ordinary tobacco smoke. It should be noted that in studies of the chemical composition of electronic cigarettes, different methods of chemical analysis (qualitative and quantitative) and different samples (smoke or aerosol, different methods of extraction of substances) were used [6].

Many of the analytical methods used in these studies were not validated in accordance with the principles of Good Laboratory Practice and Good Practice Practice. Validation is an important part of good laboratory practice (GLP) and good manufacturing practice (GMP). It is necessary to develop validated analytical methods for the analysis of chemicals of electronic cigarettes [6].

Unlike conventional cigarettes, when using electronic cigarettes, the speed of inhaled air is higher, the puff duration is longer; It is necessary for the production of aerosol. The pressure created inside the electronic cigarette with each puff varies considerably for different cartridges, different models and different manufacturers. The size and fraction of ultrafine aerosol particles in electronic cigarettes are different from ordinary cigarettes.

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Thus, the concentration of solid particles with a size of less than 1 μm is 14 μg / m3 for electronic cigarettes and 80 μg / m3 for conventional cigarettes, the concentration of solid particles with a size of less than 10 μm is 52 and 922 μg / m3, respectively. However, in a single tightening, when the aerosol does not have time to come to an equilibrium state, it contains mostly smaller particles 100–600 nm in size, which is similar to the composition of ordinary tobacco smoke. Their distribution depends on the size of solid particles in the lungs of a smoking person: smaller particles are able to penetrate into the more distal parts of the respiratory tract [6].

**Conclusion**

The composition of the aerosol produced by electronic cigarettes is extremely variable. It includes numerous toxic and carcinogenic substances that cause respiratory and cardiac disorders. Therefore, additional research is needed based on scientifically based methods for generating aerosols, methods for measuring the physical properties of aerosols, and methods for chemical analysis to standardize methods for analyzing the quality of electronic cigarettes.

## References

**1.** Dawkins L. (2013) Electronic cigarettes: what are they and are they effective? E-Cigarette Summit, London, UK: (oral presentation);

**2.** Goniewicz M., Knysak J., Gawron M., Kosmider L., Sobczak A., Kurek J., et al. . (2013) Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. Tob Control. DOI: 10.1136/tobaccocontrol-2012-050859. (Published online: 6 March 2013);

**3.** Westenberger B. (2009) Evaluation of e-Cigarettes. St.Louis, MO: Department of Health and Human Services, Food and Drug Administration, Center for Drug Evaluation and Research, Division of Pharmaceutical Analysis;

**4.** McAuley T., Hopke P., Zhao J., Babaian S. (2012) Comparison of the effects of e-cigarette vapor and cigarette smoke on indoor air quality. Inhal Toxicol 24: 850–857;

**5.** Burstyn I. (2014) Peering through the mist: Systematic review of what the chemistry of contaminants in electronic cigarettes tells us about health risks. BMC Public Health 14: 18;

**6.** Cheng, T. Chemical evaluation of electronic cigarettes/ T. Cheng // Tab. Control. – 2014. – № 23. – P. 11-17.