ISSN 2518-1629 (Online),
ISSN 2224-5308 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
С. Ж. Асфендияров атындағы Қазақ ұлттық медицина университеті

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Казахский национальный медицинский
университет им. С. Д. Асфендиярова

N E W S

OF THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
Asfendiyarov
Kazakh National Medical University

SERIES
OF BIOLOGICAL AND MEDICAL

6 (336)

NOVEMBER – DECEMBER 2019

PUBLISHED SINCE JANUARY 1963

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

«ҚР ҰҒА Хабарлары. Биология және медициналық сериясы».
ISSN 2518-1629 (Online),
ISSN 2224-5308 (Print)
Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.)
Қазақстан республикасының Мәдениет пен ақпарат министрлігінің Ақпарат және мұрағат комитетінде 01.06.2006 ж. берілген **№5546-Ж** мерзімдік басылым тіркеуіне қойылу туралы куәлік

Мерзімділігі: жылына 6 рет.
Тиражы: 300 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., 220, тел.: 272-13-19, 272-13-18,
http://biological-medical.kz/index.php/en/

Типографияның мекенжайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

«Известия НАН РК. Серия биологическая и медицинская».
ISSN 2518-1629 (Online),
ISSN 2224-5308 (Print)
Собственник: РОО «Национальная академия наук Республики Казахстан» (г. Алматы)
Свидетельство о постановке на учет периодического печатного издания в Комитете информации и архивов Министерства культуры и информации Республики Казахстан **№5546-Ж**, выданное 01.06.2006 г.

Периодичность: 6 раз в год
Тираж: 300 экземпляров

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, ком. 219, 220, тел. 272-13-19, 272-13-18,
www:nauka-nanrk.kz / biological-medical.kz

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of biology and medicine.
ISSN 2518-1629 (Online),
ISSN 2224-5308 (Print)
Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty)
The certificate of registration of a periodic printed publication in the Committee of information and archives of the Ministry of culture and information of the Republic of Kazakhstan N 5546-Ж, issued 01.06.2006

Periodicity: 6 times a year
Circulation: 300 copies

Editorial address: 28, Shevchenko str., of. 219, 220, Almaty, 050010, tel. 272-13-19, 272-13-18,
http://nauka-nanrk.kz / biological-medical.kz

Address of printing house: ST "Aruna", 75, Muratbayev str, Almaty

N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF BIOLOGICAL AND MEDICAL
ISSN 2224-5308
Volume 6, Number 336 (2019), 21 – 27 **https://doi.org/10.32014/2019.2519-1629.52**

UDC 61.614, 614.7 : 57.04, 57.042
IRSTI 76.01.94 : 87.15.17

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STUDY OF QUALITATIVE COMPOSITION OF THE ATMOSPHERIC AIR MICROPARTICLES AND THE LEVEL OF ALMATY POPULATION MORBIDITY BY PULMONARY DISEASES

Abstract. A qualitative assessment of atmospheric microparticles in winter in the city of Almaty was carried out and the prevalence of the incidence of the population with respiratory diseases was studied. Physico-chemical methods for studying ultra-small solid particles and analysis of official information on the incidence of the population were used. It was found that microparticles are a heterogeneous structure and consist of combustion products of carbonaceous materials, biogenic compounds and metals. Biological reactions of the body with the arrival of solid particles can be associated not only with their size, but also physico-chemical characteristics, such as inorganic and organic composition, which depends on the source of pollution. About half of cases in the structure of the incidence of the population of the Republic of Kazakhstan belongs to diseases of the respiratory system. Almaty city among other subjects of administrative units of the Republic of Kazakhstan takes the leading position on the incidence of the population with respiratory diseases.

Key words: microparticles, ultra-small solid particles, air pollution, transport, morbidity, respiratory diseases.

Introduction. In recent years, the problem of air pollution in the cities began to be considered in the context of a global strategy for sustainable development [1-4].

In the center of the Eurasian continent at the foot of the mountains of Zailiysky Alatau, there is the city of Almaty - the largest city in Kazakhstan and Central Asia with a population of about 2 million people. The city is characterized by a small number of industrial enterprises and heavy traffic, where vehicles are the main source of air pollution – 80 % harmful emissions [5].

The increase in morbidity and, as a result, mortality of urban population is associated with the impact of pollutants from road transport, burning of gasoline and diesel fuel, wear of brakes, tires, pavement and road dust [6].

Vehicle emissions are a significant source of ultrafine particles (ultrafine particles - UFP), defined as particles with an aerodynamic diameter of less than 100 μm [7-9]. There are the following types of ultra-small solid particles depending on their diameter: fine particles – particles with an aerodynamic diameter equal to or less than 2.5 μm (PM2.5) and coarse particles – with a diameter of 2.5 to 10 μm (PM2.5-10) [10-11]. Biological reactions of the body to the arrival of solid particles depend not only on their size, but also on the physico-chemical characteristics, such as inorganic and organic composition, dependent on the source of pollution. Currently, over 20 real-time sensors have been installed in the city of Almata, which determine the concentration of PM2.5 [12].

The purpose of the study was to make a qualitative assessment of atmospheric microparticles from various traffic points in the winter in Almaty city and the level of spread of pulmonary diseases.

Methods. The qualitative content of ultra-small particles was determined in the winter of 2018 by collecting dust and snow along the main transport highways in various administrative district of Almaty, where there are no industrial facilities. Samples were collected for 10 days at the intersection of the streets in clear, windless weather. Paper filters installed in a horizontal position in an amount of at least 3 pieces per study point at a distance of 3-5 m from the edge of the road and 2 m from the ground. After the expiration of the exposure, the filters were cut into small pieces of about 5-6 cm2, then placed in a sterile bottle with 1 liter of sterilized distilled water, sonicated for 1 minute. The resulting aqueous solutions in a volume of 100 ml were passed through a system of polycarbonate IsoporeTM polypropylene (Millipore, USA) filters of different diameters to produce ultrafine particles (UFP) with a diameter of less than 100 μm and separating them in size: 0-5 μm, 5-10 μm, 10-30 μm. Further, in the obtained filtered solutions, the combustion products of the fuel and the heavy metals were determined.

The top layer of snow from a depth of up to 10 cm and an area of 1 m^2 was collected in 1 liter sterile containers, which were pre-washed twice with distilled water to prevent secondary contamination by anthropogenic aerosols. Samples were turned off at a centrifuge at 1500 rpm for 15 minutes. The supernatant was stored at minus 20 °C until use. Microscopy was performed using a Leica light microscope. Two sampling points were identified in the studies:

– "Upper part of the city" (Abai-Nazarbayev, Dzhambul-Pushkin);

– "Lower part of the city" (Pushkin - Raiymbek).

The pH of the solutions was determined on pH-meter PH3210 Set Tw; using the conductor TetraCon 325/Cond 3110 SET2 – electrical conductivity. Acid oxides, phosphates, lead and cadmium were determined according to conventional techniques on a SpectroquantSpectroPharo 100 spectrophotometer.

Results and Discussion. Figure 1 shows the stages of particle collection, sample preparation and particle microscopy results.

Microscopic study of aqueous solutions of dust and snow passed through filters of different diameters showed inclusions of black color of various forms, classified by us as ultra-small solid particles (figure 1).

The study of acidity indices revealed that water extracts of dust (before separation into fractions) and snow have acidic indices – 4.73-5.57. The lowest pH values were characteristic for snow samples (tables 1 and 2). The electrical conductivity of the snow was almost twice as large as the water solutions of dust, which is probably due to the cumulative capacity of snow. The obtained values of electrical conductivity indices for snow samples were practically identical to each other from different surveyed collection points, which was also characteristic for samples of aqueous dust solutions. When comparing the test samples with each other, there were no significant differences in the concentrations of sulfates, nitrates and nitrites. It should be noted that sufficiently large values of nitrite indices were noted for snow samples, but they were less than the maximum permissible concentration (MPC). On the contrary, for all samples, the MPC levels of nitrates were observed to be 4.0-5.8 times higher. Indicators of phosphorus oxide for aqueous solutions of dust were in the ranges 5.3-5.9 mg/dm^3 and were 1.5 and 1.7 MPC. For snow samples, the phosphorus oxide values were greater, and were 7.73-7.90 mg/dm^3 and 2.21 and 2.26 times the MPC, respectively. Concentrations of lead and cadmium in all the investigated samples of dust and snow significantly exceeded the normalized values. In aqueous solutions of dust, lead concentration was 116.7 MPC, cadmium 142.3 MPC, and in snow samples lead concentrations were 186.7 MPC, cadmium 184.3 MPC (tables 1, 2).

Depending on the size of the particles, different levels of heavy metals in aqueous solutions of dust and snow from different parts of the city are observed (table 3). Thus, it was revealed that in practically all samples tested the highest level of lead and cadmium is observed in aqueous solutions of solid particles with a size of 0-5 μm in comparison with particles of a larger size. This is due to the fact that smaller particles have a larger contact area. At the same time, the dependence of the metal content in the samples from the city area is traced: in the "lower" part of the city the content of metals is higher in comparison with the "upper" part of the city.

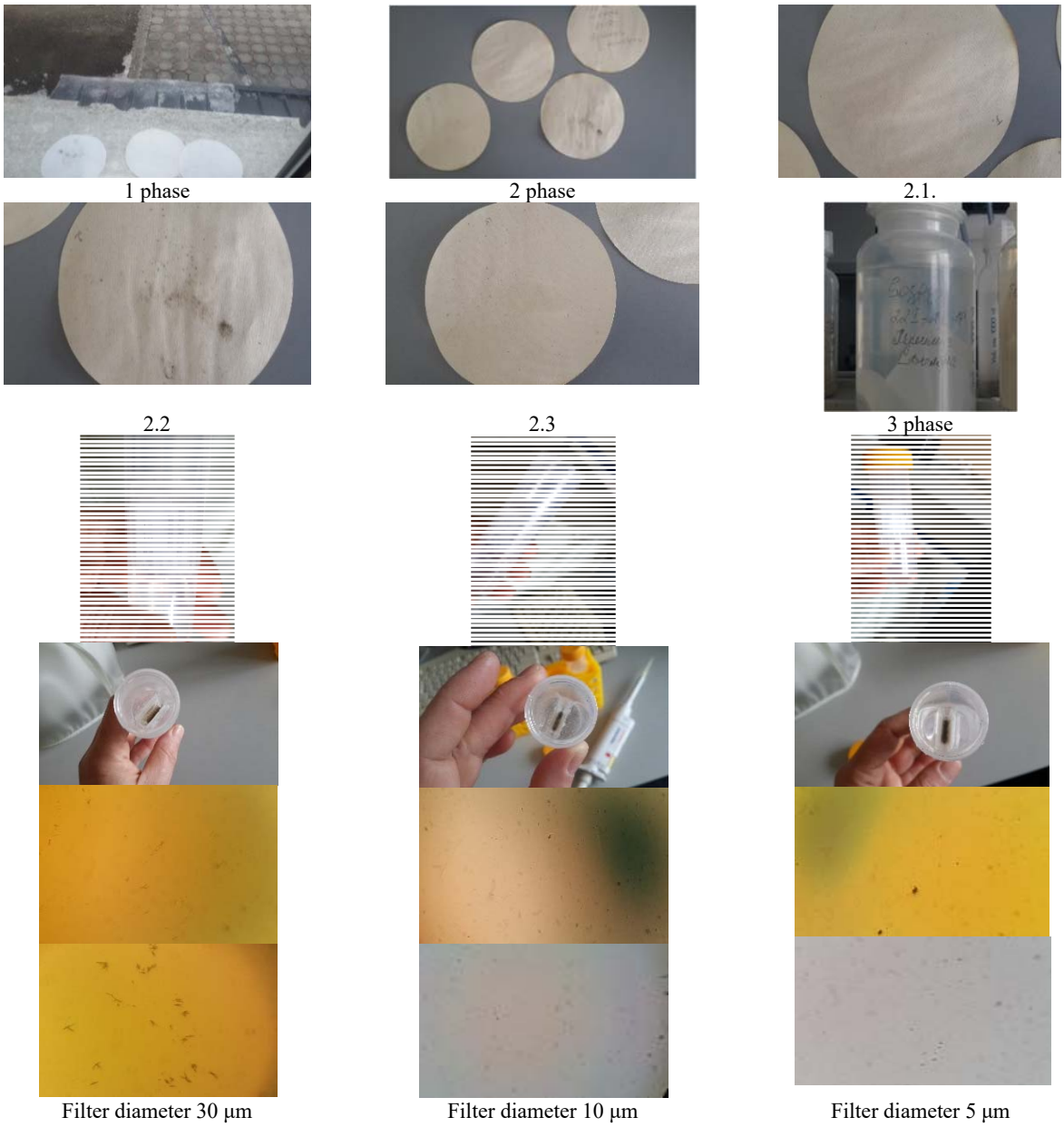

Figure 1 – Stages of particle collection, sample preparation and results of microscopic examination of ultra-small solid particles

Table 1 – Concentration of acid oxides and heavy metals in aqueous solutions of dust from different districts of Almaty, M ± m

Measured indicators	Indicators of the concentration of acid oxides and heavy metals in aqueous solutions of dust from different districts of Almaty		The values of MPC for the measured indicators, mg/dm^3
	"Upper part of the city" (Dzhambul-Pushkin)	"The lower part of the city" (Pushkin - Raiymbek)	
pH	5,56 ± 0,21	4,96 ± 0,23	–
Electrical conductivity, µS/cm	75,83 ± 2,99	68,53 ± 0,57	–
SO_4^{-2} , mg/dm^3	65,60 ± 1,94	69,66 ± 1,23	500,0
NO_2^- , mg/dm^3	15,06 ± 1,89	12,66 ± 0,31	3,0
NO_3^- , mg/dm^3	26,63 ± 0,30	27,46 ± 0,59	45,0
PO_4^{-2} , mg/dm^3	5,30 ± 0,30	5,90 ± 0,55	3,5
Pb^{-2} , mg/dm^3	3,50 ± 0,16	4,26 ± 0,34	0,03
Cd^{-2} , mg/dm^3	4,30 ± 0,16	5,86 ± 0,21	0,001

Table 2 – Concentration of acid oxides and heavy metals

in aqueous snow solutions from different districts of Almaty, M ± m

Measured indicators	Indicators of the concentration of acid oxides and heavy metals in aqueous solutions of snow from different districts of Almaty		The values of MPC for the measured parameters, mg/dm^3
	"The upper part of the city" Abay - Nazarbayev	"The lower part of the city" (Pushkin - Raiymbek)	
pH	4,73 ± 0,14	5,23 ± 0,18	–
Electrical conductivity, μS/cm	134,56 ± 0,98	144,20 ± 2,33	–
SO_4^{-2} , mg/dm^3	65,13 ± 0,73	67,36 ± 0,90	500,0
NO_2^- , mg/dm^3	17,40 ± 0,20	12,30± 0,16	3,0
NO_3^- , mg/dm^3	33,4 ± 0,85	35,30 ± 0,68	45,0
PO_4^{-2} , mg/dm^3	7,90 ± 0,45	7,73 ± 0,35	3,5
Pb^{-2} , mg/dm^3	5,60 ± 0,26	5,53 ± 0,46	0,03
Cd^{-2} , mg/dm^3	6,76 ± 0,39	6,16 ± 0,16	0,001

Table 3 – Metal content in samples of water solutions of dust and snow in different parts of Almaty depending on the size of solid particles, M ± m

District of the city	Measured pollution indicators		Dimensions of solid particles, μm		
			0-5	5-10	10-30
"Upper part of the city" (Dzhambul-Pushkin)	Air	Pb^{2+}	3,7 ± 0,4	2,8 ± 0,4*	2,4 ± 0,2*
		Cd^{2+}	3,9 ± 0,5	3,3 ± 0,6*	3,6 ± 0,3
"The lower part of the city" (Pushkin - Raiymbek)	Air	Pb^{2+}	4,0 ± 0,6	3,4 ± 0,1*^{o}	3,0 ± 0,1* ^{o}
		Cd^{2+}	5,0 ± 0,6^o	3,4 ±0,7*	3,5 ± 0,5*
"The upper part of the city" (Abay - Nazarbayev)	Snow	Pb^{2+}	5,0 ± 0,4	3,5 ± 0,5*	3,5 ± 0,5*
		Cd^{2+}	5,9 ± 0,4	3,4 ± 0,6*	3,3 ± 0,2*
"The lower part of the city" (Pushkin-Raiymbek)	Snow	Pb^{2+}	5,0 ± 0,4	4,3 ± 0,7	4,3 ± 0,6^o
		Cd^{2+}	6,2 ± 0,4	4,5 ± 0,6* ^{o}	3,0 ± 0,5*
Note: for P ≤ 0.05 (the Mann-Whitney U test). * - in comparison with the particle size; ^{o} - compared to the place of sampling.					

Table 4 shows the incidence rates of respiratory diseases in the structure of the overall morbidity of the population of the Republic of Kazakhstan on the basis of statistical data of the single site of the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan www.stat.gov.kz. There is a trend of increasing respiratory rate in the past five years by almost 2 % and they make up on average 40 % of cases. In this case, the incidence of respiratory diseases among children is more than 60 % with an increase of 2 % over the past 5 years.

Table 4 – Morbidity of the population with respiratory diseases of the Republic of Kazakhstan in the structure of the overall incidence

Diseases of the respiratory system in the structure of the general morbidity by the main groups of diseases by years, %	2012 year	2013 year	2014 year	2015 year	2016 year
Morbidity of the adult population	41,6	41,8	41,5	42,0	43,5
Morbidity of children aged 0-14 years	59,8	60,1	59,7	60,0	61,8

The city of Almaty holds a leading position on the incidence of respiratory diseases among other administrative units of the Republic of Kazakhstan with an increase of 80 912 cases over the past five years (figure 2).

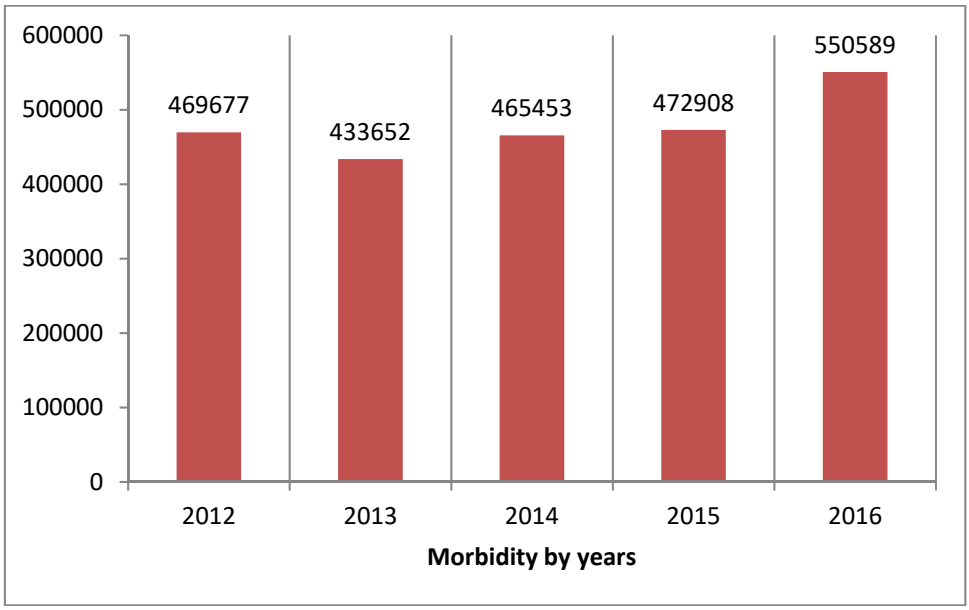

Figure 2 – Morbidity of the Almaty city population with respiratory diseases.

The problem of air quality is of vital importance in ensuring the health of the population in the terms of increasing technogenic and climatic changes. To date, the pathogenetic mechanisms of diseases such as asthma, cardiovascular, atherosclerosis have been determined. It has been shown that ultrafine solids (UFP) can not cause death in healthy people, but may increase the mortality rate among vulnerable groups, such as children, the elderly or people with weakened immune systems [12].

It is believed that ultrafine particles have the greatest impact on human health [13]. Increasing the level of their content increases the number of respiratory and cardiovascular disease [14]. Such particles have a large cumulative ability, the ability to penetrate the epithelium, as well as an increased proportion of organic material and metals in the composition, which leads to their high oxidative potential [15].

Epidemiological studies have found a positive correlation between the short-term exposure to elevated levels of airborne particles having an average diameter of less than 2.5 μm and the population mortality. The effect of PM2.5 is statistically significant in cardiovascular and respiratory infections, reducing life expectancy by about 8.6 months [16].

Conclusions. Solid particles are a heterogeneous structure and consist of combustion products of carbonaceous materials, biogenic compounds and metals. In all the investigated areas of Almaty, the MPC is exceeded for nitrites, phosphates, lead and cadmium.

With the decrease in the size of solid particles, the process of settling of heavy metals on their surface increases, which makes them most hazardous to health.

About half of the cases, according to official statistics, in the structure of morbidity of the population of the Republic of Kazakhstan belong to the diseases of the respiratory system. Almaty among other subjects of administrative units has a leading position on the morbidity of respiratory diseases.

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АЛМАТЫ ҚАЛАСЫ ХАЛҚЫНЫҢ ӨКПЕ АУРУЛАРЫМЕН АУРУШАҢДЫҚ ДЕҢГЕЙІН ЖӘНЕ АТМОСФЕРАЛЫҚ АУА МИКРОБӨЛШЕКТЕРІНІҢ САПАЛЫҚ ҚҰРАМЫН ЗЕРТТЕУ

Аннотация. Алматы қаласында қысқы кезеңде атмосфералық ауаның микробөлшектеріне сапалы баға берілді және халықтың тыныс алу ағзалары ауруларымен аурушаңдығының таралу деңгейі зерттелді. Аса аз қатты бөлшектерді зерттеудің физика-химиялық әдістері және халықтың аурушаңдығының ресми ақпаратын талдау қолданылды. Микробөлшектер гетерогенді құрылымды білдіреді және көміртекті материалдардың,

биогенді қосылыстар мен металдардың жану өнімдерінен тұрады. Қатты бөлшектер түскен кезде ағзаның биологиялық реакциялары олардың өлшемдерімен ғана емес, сонымен қатар ластану көзіне байланысты органикалық емес және органикалық құрам сияқты физикалық-химиялық сипаттамалармен байланысты болуы мүмкін. Қазақстан Республикасы халқының аурушаңдығы құрылымындағы жағдайлардың жартысына жуығы тыныс алу органдары ауруларына жатады. Алматы қаласы Қазақстан Республикасының әкімшілік бірліктерінің басқа субъектілерінің арасында халықтың тыныс алу ағзалары ауруларымен аурушаңдығы бойынша жетекші орынға ие.

Түйін сөздер: микробөлшектер, өте аз қатты бөлшектер, атмосфералық ауаның ластануы, көлік, ауру, тыныс алу органдарының аурулары.

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ИЗУЧЕНИЕ КАЧЕСТВЕННОГО СОСТАВА МИКРОЧАСТИЦ АТМОСФЕРНОГО ВОЗДУХА И УРОВНЯ ЗАБОЛЕВАЕМОСТИ ЛЕГОЧНЫМИ БОЛЕЗНЯМИ НАСЕЛЕНИЯ Г. АЛМАТЫ

Аннотация. Проведена качественная оценка микрочастиц атмосферного воздуха в зимний период в городе Алматы и изучен уровень распространения заболеваемости населения болезнями органов дыхания. Использованы физико-химические методы изучения сверхмалых твердых частиц и анализ официальной информации заболеваемости населения. Установлено, что микрочастицы представляют собой гетерогенную структуру и состоят из продуктов горения углеродистых материалов, биогенных соединений и металлов. Биологические реакции организма при поступлении твердых частиц могут быть связаны не только с их размерами, но и физико-химическими характеристиками, такими как неорганический и органический состав, который зависит от источника загрязнения. Около половины случаев в структуре заболеваемости населения республики Казахстан принадлежит заболеваниям органов дыхания. Город Алматы среди других субъектов административных единиц республики Казахстан занимает лидирующее положение по заболеваемости населения болезнями органов дыхания.

Ключевые слова: микрочастицы, сверхмалые твердые частицы, загрязнение атмосферного воздуха, транспорт, заболеваемость, болезни органов дыхания.

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REFERENCES

[1] United Nations. The New Urban Agenda (**2016**). Available: http://habitat3.org/wp-content/uploads/NUA-Russian.pdf (as of 23.08.2019) (in Russian).

[2] Esenbekova AB, Alan R (**2018**) Economic mechanisms of providing of sustainable development of the Republic of Kazakhstan in the conditions of global warming, Bulletin of national Academy of sciences of the Republic of Kazakhstan, 3:197-202 (in Eng).

[3] World Health Organization. Health and the Environment: Addressing the health impact of air pollution (**2015**). Available: https://apps.who.int/iris/bitstream/handle/10665/253206/A68_ACONF2Rev1-en.pdf?sequence=1&isAllowed=y (as of 01.08.2019) (in Eng).

[4] Karimova AT, Sarkulov MN, Yesengulova MN, Gavrina AV (**2018**) Psychological aspects of medical Health care, 5, 375:85-92 (in Eng) https://doi.org/10.32014/2018.2518-1467.11

[5] http://m.zakon.kz/4686006-bakytzhan-sagintaev-my-ljubim-almaty-i.html (as of 29.08.2019).

[6] Gan W, Tamburic L, Davies HW, Demers PA, Koehoorn M, Brauer M (**2011**) Long-Term Exposure to Traffic-Related Air Pollution and the Risk of Coronary Heart Disease Hospitalization and Mortality, Environmental Health Perspectives 119 (4): 501-507. DOI:10.1289/ehp.1002511(in Eng).

[7] Pakkanen TA, Loukkola K, Korhonen CH (**2001**) Sources and chemical composition of atmospheric fine and coarse particles in the Helsinki area, Atmospheric Environment 35(32): 5381-5391. DOI:10.1016/S1352-2310(01)00307-7 (in Eng).

[8] Zavala M, Herndon SC, Wood EC (**2009**) Evaluation of mobile emissions contributions to Mexico City's emissions inventory using on-road and cross-road emission measurements and ambient data // Atmospheric Chemistry and Physics 9: 6305-6317. DOI:10.5194/acp-9-6305-2009 (in Eng).

[9] Pey J, Querol X, Alastuey A. (**2009**) Source apportionment of urban fine and ultra-fine particle number concentration in a Western Mediterranean city, Atmospheric Environment 43 (29): 4407-4415. DOI:10.1016/j.atmosenv.2009.05.024 (in Eng).

[10] Shields LG, Suess DT, Prather KA (**2007**) Determination of single particle mass spectral signatures from heavy-duty diesel vehicle emissions for PM 2.5 source apportionment, Atmospheric Environment 41 (18): 3841-3852. DOI:10.1016/j.atmosenv.2007.01.025 (in Eng).

[11] Mariani RL, de Mello WZ (**2007**) PM2.5-10, PM2.5 and associated water-soluble inorganic species at a coastal urban site in the metropolitan region of Rio de Janeiro, Atmos Environ 41: 2887-2892. DOI:10.1016/j.atmosenv.2006.12.009 (in Eng).

[12] Pope CA, Burnett RT, Thun MJ, Calle EE, Krewski D, Ito K, Thurston GD (**2002**) Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution, Journal of the American Medical Association, 287 (9): 1132-1141. DOI:10.1001/jama.287.9.1132 (in Eng).

[13] Anderson JO, Thundiyil JG, Stolbach A (**2012**) Clearing the air a review of the effects of particulate matter air pollution on human health, Journal of Medical Toxicology 8(2): 166-175. DOI:10.1007/s13181-011-0203-1 (in Eng).

[14] Heal MR, Kumar P, Harrison RM (**2012**) Particles, air quality, policy and health, Chem Soc Rev 41: 6606–6630. DOI:10.1039/c2cs35076a (in Eng).

[15] Morgan TE, Davis DA, Iwata N, Tanner JA, Snyder D, Ning Z, Kam W, Hsu Y, Winkler JW, Chen JC, Petais NA, Baudry M, Sioutas C, Finch CE (**2011**) Glutamatergic Neurons in Rodent Models Respond to Nanoscale Particulate Urban Air Pollutants in Vivo and in Vitro, Environmental Health Perspectives 119 (7): P. 766-772. DOI: 10.1289/ehp.1002973 (in Eng).

[16] Dominici F, Peng RD, Bell ML, Pham L, McDermott A, Zeger SL, Samet JM (**2006**) Fine particulate air pollution and hospital admission for cardiovascular and respiratory diseases, Journal of the American Medical Association, 295 (10):1127-1134. DOI: 10.1001/jama.295.10.1127 (in Eng).

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ISSN 2518-1629 (Online), ISSN 2224-5308 (Print)

http://biological-medical.kz/index.php/en/

Редактор *М. С. Ахметова, Т. М. Апендиев, Д. С. Аленов*
Верстка на компьютере *Д. Н. Калкабековой*

Подписано в печать 06.12.2019.
Формат 60x881/8. Бумага офсетная. Печать – ризограф.
2,75 п.л. Тираж 300. Заказ 6.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-18, 272-13-19