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ALLERGY, ASTHMA & IMMUNOPHYSIOLOGY: FROM BASIC SCIENCE TO CLINICAL MANAGEMENT

Editor
Professor REVAZ SEPIASHVILI

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Alteration of profile of atmospheric suspensions as magnification factor of immunoallergic diseases

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Abstract

The likely dependence of immunoallergic diseases on the profile of atmospheric city suspension is discussed in the article. Hypotheses about the rise in indetermination of the "atmospheric suspension of the Earth" based on the results of laser granulometry and scanning electronic microscopy are presented. Keywords: suspensions, nanoparticles, microparticles, random.

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Atmospheric suspension is multicomponent and different dimensions system, so large number of diverse responses of living systems is likely to exist. For example, natural components (pollen, animal dander, volcanic dust, etc.) as well as technogenic ones (carbon black, synthetic particles, etc.) occur in suspensions. The dimension is one of the most important characteristics in evaluation the toxic or other effects of a dispersed system on living organism. The particles from 10 nm to 3.1 mm size are suspended in the atmosphere [Bogatikov, 2003; Skinner, 2007; Adushkin, Popel, 2012; Golokhvast et al., 2012]. There are quite number of posts showing that nanoparticles as size class have the highest toxicity, almost regardless of the material type [Silbergeld et al., 2011].

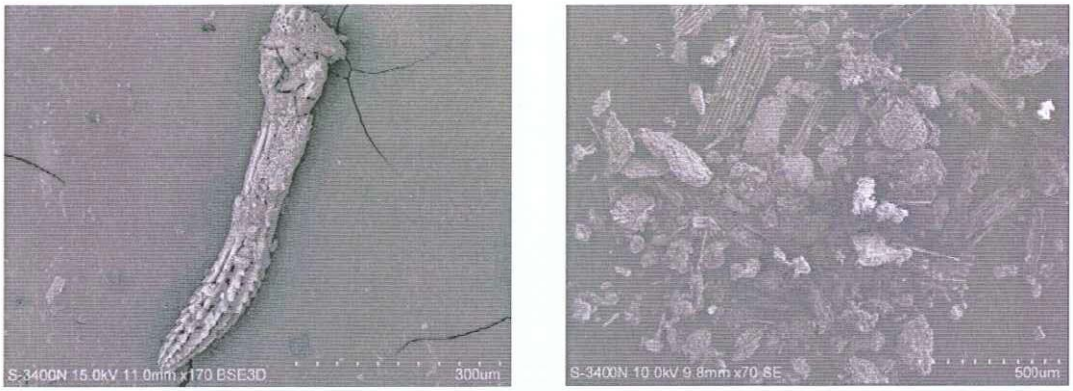
It's well known that, XXI century is a century of allergic diseases. There are lots of reasons for this, but in our opinion, one of the most significant one is increased quantity and quality change of suspended matter in the atmosphere due to anthropogenic component.

Methods

We have studied the atmospheric suspensions was in the snow collected in the largest cities of the Far East of the Russian Federation such as Vladivostok, Khabarovsk, Birobidzhan, Blagoveshchensk, Ussuriysk. To avoid secondary contamination, samples (atmospheric precipitation in the form of snow), were gained during the snowfall. Only the top layer (5-10 cm) of fresh snow was selected. Snow was placed into sterile containers 3 liter volume, pre-washed with distilled water to exclude dust. Granulometric analysis of sediments is performed on laser particle analyzer Fritch Analysette Nanotec 22 (60 ml liquid melted snow after resuspension in a mode «nanotec» with settings «quartz/water 20^0C» and «carbon/water 20^0C» was studied). The hylic test of suspensions was performed on light microscope Nikon SMZ1000 and scanning electronic microscope Hitachi S-3400N with energy dispersive spectrometer Thermo Scientific. Spraying of samples for electronic microscope was produced platinum.

Results

The issue of increasing suspended allergenic matter is quite obvious. If we consider the profile of suspensions of "pre-technogenic" era, so a list of components in increasing their number might look like: mineral particles weathering crust, meteoric and volcanic dust, forest fires ash, plant detritus particles, products of chemical reactions in the upper atmosphere, pollen, animal hair, insects and parts of their bodies, aeroplankton organisms, fragments of marine organic matter (thallus algae, echinoderms, shells). As an example of "clean zones" were used coastal and park areas of cities (fig. 1).

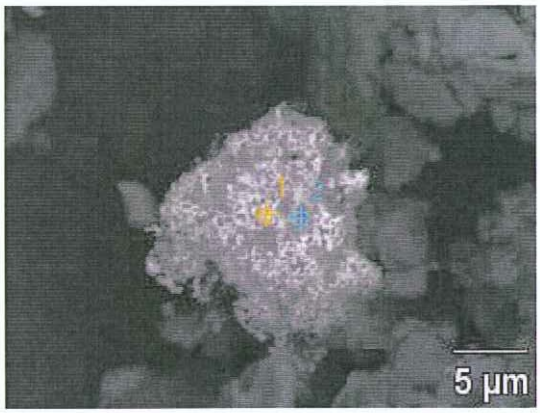


A B

Fig. 1. A) The particle of Marine organics (Energy dispesive analysis shows silicon content over 90%) in the samples collected in one of the coastal districts Vladivostok. Scanning electronic microscopy in the secondary electrons. Magnification x 170.

B) The particles of natural minerals and plant detritus from a sample of snow gathered in one district of Birobidzhan. Scanning electronic microscopy in the secondary electrons. Magnification in x70.

Not a few metal particles and their oxides in the natural and technogenic suspensions occur in the native state, not in the form of salts (fig. 2).



Element	Spectr 1	Spectr 2
	Mass. %	Mass. %
C	8.82±0.13	16.61±0.14
O	7.30±0.24	22.01±0.22
Mg		12.39±0.09
Al	1.70+0.10	2.00+0.08
W	**82.19±0.56**	**46.99±0.34**
Total	100,00	100,0

Fig. 2. Wolfram microparticle from the snow sample collected in one of the districts of Blagoveshchensk. The data of energy dispersive analysis are presented in the next table. Scanning electronic microscopy of the secondary electrons.

The particles of W, as well as V, Zr, Ir, Bi, can be attributed to a single observation, whereas according to our data, about 70-80% of the detected metals are Fe, Pb, Ba, Zn.

Although mineral particles, meteorite and volcanic dust, organic detritus are in composition of the natural background atmospheric mist, so living organisms have had to adapt to them from the very beginning of life on Earth, the responses to them, for example, are pollinosis and pneumoconiosis.

Difference between the profiles of natural and technogenic period concern the particle size distribution. Studying the samples of cities of the Far East of Russia, we have divided the suspension on seven size classes: 1) from 0.1 to 1 microns(corresponding to PM1), 2) from 1 to 10 microns (corresponding to PM10), 3) from 10 to 50 microns, 4) from 50 to 100 microns and 5) from 100 to 400 microns, 6) from 400 to 700 microns, and 7), more than 700 microns. Natural suspensions usually comprise of particles of one or two classes (usually 5, 6 and 7) and sufficiently homogeneous, whereas the typical technogenic particulate matter is very diverse and all size classes can be presented in the sample. It is vital to note that 1, 2 and 3 size classes dominate close to major traffic intersections in cities (fig. 3).

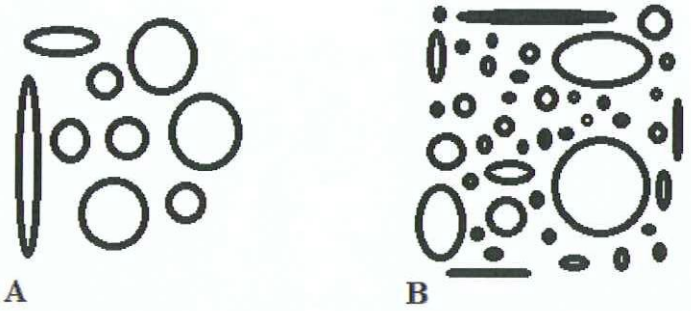


Fig. 3. Morphometric differences between the profile of a typical natural (A) and technogenic suspension (B) according on the results of laser granulometry and scanning electronic microscopy.

The particles of the smallest size classes (1 and 2) rarely present in natural suspensions. In particular, most often in nature nanoparticles are the product of volcanic activity, cosmic dust and forest fires, and in water - black smokers (Bogatikov, 2003; Adushkin, Popel, 2012). According to our observations nanoparticles aggregate with each other in presence of moisture or are adsorbed on organic detritus. The difference in the qualitative composition of the suspensions also looks quite persuasively (fig. 4).

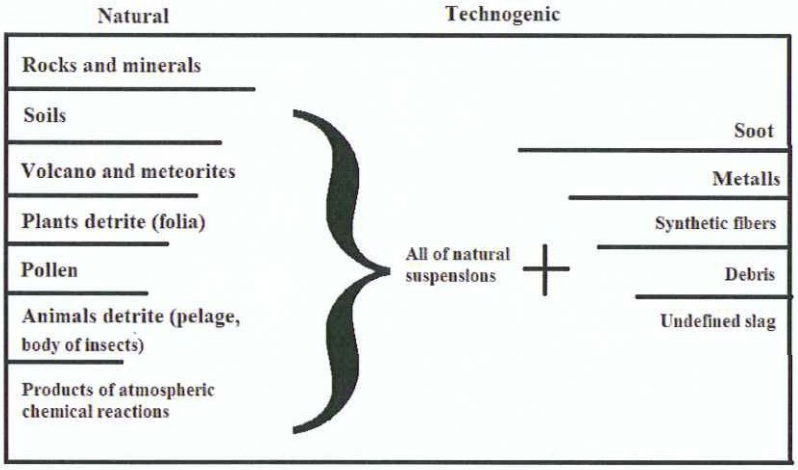


Fig. 4. The qualitative difference between the profile of a typical natural and technogenic suspensions according to the results of scanning electronic microscopy with energy dispersive analysis.

Conclusion

Profile of suspensions of "technological" era continues to change and today there are increasing industrial emissions, power plants and boilers, car exhaust particles (soot and metals microparticles), products of rubbish combustion, waste and emissions of the construction industry, synthetic fibers, rubber and asphalt particles. From the point of view of morphology the growth of fibrous (elongated) particles is also worth noting. In our opinion, the organism, and to a greater extent, the respiratory system, so to speak, is "difficult" to deal with dispersed systems consisting of different components of the ever-changing and value types. This is due, first of all, the available mechanisms of adaptation and removal of solid particles, which were formed in a "pre-technogenic" suspensions profile (fig. 3A).

As a prediction is to assume that if the increasing indetermination of the "atmospheric suspension of Earth" continues, it threatens, at least, further growth of allergic and respiratory diseases, which in turn will lead to increasing mortality.

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