The Role of Saline Aerosols in the Prevention and Therapy of Cardio-respiratory and Osteo-muscular Afflictions

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The saline aerosols generated in gaseous media, as nanodispersions, behave, with respect to the concentration levels and the lifespan, as trimodal distributions (the three domains with Gaussian distributions: fine or Aitken under 50 µm, medium between 50 and 500 µm and, respectively, coarse or large between 500 and 1000 µm). The generation in latent state is dependent on the active surface of the source (number of generator centres, the size and position of the fluorescences, the porosity, size and shape of the source, etc.), the climatic parameters, but also on a series of other characteristics of the gaseous medium. Our team has demonstrated experimentally that saline aerosols, NaCl type, besides the ability to prevent and treat broncho-respiratory and cardiac conditions, through coexistence of saline aerosols of other cations than sodium, and of the iodine anion, have for certain levels of concentrations propitious effects over the immune, bone and muscular systems. Similarly proved has been the positive influence on the development of children, as well the determinant role in increasing athletic performance and of other human subjects performing intense activities.

Keywords: solion, halochamber, microclimatic parameters, biometric characteristics, cardio-respiratory and osteo-muscular systems

The obtaining, characterization and behaviour of saline aerosols has been addressed by our team for the last 18 years, under the influence of the results obtained in identifying a number of evolutionary markers of the salt rocks and brine from old wells (shafts) from the Moldavian piedmont area east of the Eastern Carpathians, Romania. The Subcarpathian area of Moldavia houses over 200 salt springs, with a notable role in the development of the human habitat [1-3]. The importance of the salt and of the salt springs was first underlined in the 1950s by the geographer Ion ‘andru and chemist Petru Poni from the Alexandru Ioan Cuza University of Iasi, who emphasised the importance of the salt springs from a number of areas of eastern Romania (viz. the Neam, Cacica and, respectively, Targu Ocna - Slanic Moldova depressions) starting with the Eneolithic Precucuteni and Cucuteni cultures [1-3]. More than 40 years ago, the Iasi archaeologist Nicolae Ursulescu published the first specialised study in Romania on the archaeological remains discovered in the proximity of salt springs, dating from the Neolithic (the Starcevo-Cris culture) to the Middle Ages [1, 4]. Following the discovery of a Chalcolithic tell at Poduri, then at Cucuieti and Tocli (the first in Bacau County, the second in Neam County), near salt springs, three groups of archaeologists started a series of researches on the possible relationship between these springs and the habitation in these tells [1, 5]. The problematical of salt spring exploitation was later tackled by a series of international research projects [1, 6-10].

The modern dating methods have allowed the confirmation of the archaeologists’ suppositions, and currently the oldest exploitation of salt from salt springs in Europe, perhaps in the world, dating from 6050-5500 B.C. (the Starcevo-Cris culture), is considered to be found at Lunca-Poiana Slatinei, Neamt County, Romania [1, 11]. The salt springs were also used by the later Chalcolithic communities [1, 12].

The paper presents the results obtained in the last years by our team concerning the obtaining, the chemical and physico-structural characterisation of saline aerosols, used in the prevention, therapy and production of environments with clean air. Analysis is performed on the two sublevels from the first Aitken dispersion group of the trimodular systems (Aitken, medium and large/coarse or sedimentable). Thus, two subgroups can be distinguished in the first granulometric distribution of the Aitken particles, namely of hydrated particles, known as solions, and anhydrous particles, in the form of weakly superficially hydrated nanopolyhedrons. The solions have a mutable glomerular structure, which at the level of in vivo tissue through deliquescence allow directing the ions towards specific channels, activating biochemical processes, while the nanopolyhedrons, being strongly hydrophilic, will make chronic any affliction by strongly dehydrating the tissue. Two types of artificial solion-producing halochambers were experimented upon and patented by our team, which on account of their results were found to be originally effective in terms of the benefits for juvenile development (secondary school students), particularly for females, who...
displayed a greater receptivity to the human performance improvement effect.

Therapy with rock salt, brine and aerosols

A particular place concerning naturist therapy is held by aerosol cures in natural (salt mines) or artificial halochambers (surface rooms, generating solions with levels between 0.6 and 6.0 mg/m³), and by helomarine cures, which help alleviate or even heal various respiratory conditions, blood diseases, rheumatic and orthopaedic conditions, inflammatory gynaecological conditions, skin diseases, etc. The cheapest of the two is the maritime climate, which favours gaseous exchanges in tissues, lowers the respiratory rate, improves the haemoglobin gas exchange (because of the increased barometric pressure). Furthermore, characteristic elements that can be mentioned include: uniform atmospheric pressure, small temperature variations, almost constant humidity, rich ultraviolet radiation, frequent winds (sea breeze), the high sodium chloride and iodine. This climate raises appetite and tones-up the body, excites the hematopoietic system, increases the rate of diuresis, and stimulates the nervous system.

Salt therapy is used for alleviating certain medical conditions, such as severe asthma, chronic and allergy rhinitis, polyposis, thyroid dysfunctions, pharyngitis, otitis, tonsillitis, sinusitis, colds, coughs, air tract conditions, allergies (this therapy is also recommended for children), various skin problems, eczema, dermatitis, psoriasis, viral infections, insomnia, anxiety, and restoring the immune system. But since abuse is one step further from use, nowadays alimentary sodium chloride has rather become a poison than a cure. Nevertheless, in the case of moderated consumption, mild forms of salt therapy are effective in the treatment of conditions, such as severe asthma, chronic and allergy rhinitis, polyposis, thyroid dysfunctions, pharyngitis, otitis, tonsillitis, sinusitis, colds, coughs, air tract conditions, allergies (this therapy is also recommended for children), various skin problems, eczema, dermatitis, psoriasis, viral infections, insomnia, anxiety, and restoring the immune system.

Therapy in halochambers

The air in artificial surface halochambers, with its aseptic and bactericide properties, improves the activity of the respiratory tract, starting with the segment of the nasal cavity and ending with the last pulmonary alveolus. A particular place concerning naturist therapy is held by aerosol cures in natural (salt mines) or artificial halochambers (surface rooms, generating solions with levels between 0.6 and 6.0 mg/m³), and by helomarine cures, which help alleviate or even heal various respiratory conditions, blood diseases, rheumatic and orthopaedic conditions, inflammatory gynaecological conditions, skin diseases, etc. The cheapest of the two is the maritime climate, which favours gaseous exchanges in tissues, lowers the respiratory rate, improves the haemoglobin gas exchange (because of the increased barometric pressure). Furthermore, characteristic elements that can be mentioned include: uniform atmospheric pressure, small temperature variations, almost constant humidity, rich ultraviolet radiation, frequent winds (sea breeze), the high sodium chloride and iodine. This climate raises appetite and tones-up the body, excites the hematopoietic system, increases the rate of diuresis, and stimulates the nervous system. Salt therapy is used for alleviating certain medical conditions, such as severe asthma, chronic and allergy rhinitis, polyposis, thyroid dysfunctions, pharyngitis, otitis, tonsillitis, sinusitis, colds, coughs, air tract conditions, allergies (this therapy is also recommended for children), various skin problems, eczema, dermatitis, psoriasis, viral infections, insomnia, anxiety, and restoring the immune system.

Therapeutic environments make use of gaseous submicronic microdispersions, both in the form of hydroaerosols and semidried saline aerosols.

According to the type of source, the activity of the particles, respectively their life time and the environmental conditions, the atmospheric aerosols present a dimensional distribution and a somewhat regulated concentration, as a consequence of the difference between the production speed and the loss speed, related to a series of condensation, coagulation, peptization, electro-neutralisation, sedimentation (destabilisation), etc. processes.

Likewise, according to the characteristics of the source and the environmental conditions in which they are obtained, the aerosols display varying shapes, granulometries and concentrations; in this regard, the specialised literature employs the following terms: saline aerosols, haloaerosols, aeroanions, and solions - they differ in terms of morphology, internal structure (ratio between the NaCl polyhedron nanostructures and the oligomers of the solions, as well as of the particular properties of these spaces. A good knowledge of the subterranean environmental parameters allow us to advance a number of considerations regarding the influence of such environments can have on the human organism.

The saline aerosols in the atmosphere are formed through bursting of bubbles from concentrated solutions, superficial dispersion of efflorescences, mechanical erosion, and actions of chemical desolutioning followed by emissions or emanations. Their diameters vary between 10 nm and 10,000 nm, and they can stay in the atmosphere for time periods ranging from several hours to several weeks. The stability range or the capacity to disperse is conditioned by the variations in the microclimate parameters, by chemical, microbiological, radiative, and sound pollution, and are also influenced by the kinetics of the repeated collisions with the air and water molecules in the atmosphere. The particles, which through electrostatic or stearic coagulation (combination) between them or with other nano- or microparticles, acquire diameters between 1000 nm and 10,000 nm, become instable and deposit, under the effect of gravitational sedimentation.

This wide domain of sizes of the aerosols particles can be grouped, according to the size and composition, into the following classes:

- Simple ions, anhydrous or solvated (small, under 0.5 nm; medium, between 0.5 nm and 10 nm; large, over 10 nm);
- Aitken or nanometric aerosols (ionic aggregates between 0.5 nm and 50 nm, including, only on terms of size, the last two groups of simple medium and large ions);
- Submicronic aerosols (under 1.0 µm, that is under 1000 nm), which includes the small (between 50 nm and 100 nm), medium (between 100 nm and 500 nm) and large or coarse (between 500 nm and 1000 nm) aerosols;
- Micronic aerosols (between 1000 and 10,000 nm);
- Suppermicronic aerosols (over 10,000 nm), very unstable, with very small life times, in certain systems induced by stearic or electrostatic stabilisation.

Procedures for generating saline aerosols

The NaCl aerosols originating from various natural (maritime and saltwork aerosols) or artificial sources (halochambers, saline inhalers) have multiple practical implications, such as: the prophylaxis and therapy of respiratory conditions, in improving the parameters of the cardio-vascular and psycho-neuromotor systems, in purifying and improving the quality of the atmospheric air (the clean air effect), and, as of late, increasing the performance of athlete and human subjects performing intense physical work.

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through the concentration and size of the particles [21-28].

**The size and shape of the NaCl aerosol particles**

It is known that, from the chemical point of view, sodium chloride is a strong saline electrolyte, with high hydrophilic and limited water solubility (35.7 g/100 g H₂O at 0°C and, respectively, 39.12 g/100 g H₂O at 100°C) or in other polar solvents, which, both in liquid and gaseous media, can exist as crystalline nanodispersions interacting with the dipoles of the dispersion medium, which renders them with a variable chemical structure, in glomerular aeronion form [1, 2, 28].

Because the particles have a negative charge, their life time varies from several minutes to several days, and depends on a series of exogenous factors-external or environmental (humidity, temperature, air movement, pressure, effects of solar radiation, the presence of aerocations, isotope radiation, sound pollution, etc.); but also by certain endogenous factors - shape, size and nature of the granules (powders), manner of obtaining or the type of source, the speed of production (source capacity or output), rate of coagulation and sedimentation, etc. [20, 23].

The dynamics of these processes is determined by the intensity of the exogenous factors. In liquid, watery media, the size of the particles ranges from the medium diameter (50 nm); medium particles (with a diameter between 50 and 250 nm); large particles (with a diameter between 250 and 1000 nm); and giant particles (with a diameter greater than 1000 nm (up to several tens of microns)).

The granulometry, structure and dynamics of the two groups of particles (solions and weakly hydrated polyhedrons) in gaseous media are determined by the intensity of the microclimate factors, by microbiological, chemical and radiative agents. Thus, solion activity relates to the humidity of the medium, to the degree of hydration with water dihydrols, trihydrols, up to pentahydrols, and to the mechanism of their suprastructuration processes (coordinative aquatemplating of the Na⁺ cations, suprastructuration of the water pentahydrols and of the NaCl nanopolyhedrons, etc.), acquiring, at the nanostructural level, multiple shapes with spatial structures similar to snow flakes or mutable glomeruli. The multiple structural ordering with spherical symmetry is explained by the compatibility between the cubic crystalline lattice of sodium chloride and that of the water pentahydrols (H₂O)₅.

According to the activity and, respectively, their life time, the haloaeronal particles display a somewhat regular dimensional distribution, according to the speed of production and of loss through various processes. From this point of view, they are grouped into five dimensional groups or levels: simple ions (with a diameter under 0.5 nm); Aitken particles (with a diameter between 0.5 and 50 nm); medium particles (with a diameter between 50 and 250 nm); large particles (with a diameter between 250 and 1000 nm); and giant particles (with a diameter greater than 1000 nm (up to several tens of microns)).

The group of the Aitken particles contains both the nanostructures: solions and nanopolyhedrons, in the form of a dimodal system, with an equilibrium shift towards one of the shapes, according to the size of the kinetic and thermodynamic parameters of the suprastructuration processes, in correlation with the microclimate and pollution (microbiological, chemical, radiative and/or sonic) factors.

The microclimate inside the halochamber must have a constant humidity (a relative air humidity of 40-60%) and a temperature of 18-24°C; these parameters create favourable conditions for patients, and constitute a stable medium for solvated aerosols [29, 30].

**Procedures for producing saline aerosols**

Alongside the halochambers found inside salt mines, much used in prophylaxis and therapy, a series of procedures have been developed after 1990 for producing saline aerosols, on a NaCl basis, as such or mixed with other inorganic or organic compounds, with chemical compositions pre-set according to the scope. According to the physical-chemical, hydric and thermic production process, can be assigned to four groups:

- **diversion or mechanic erosion**, followed by physical dispersion into the halochamber atmosphere using a gas flow of the saline systems, in the form of sucked precipitates, fine micro-crystallites, extruded micro-pills, or of those obtained through recrystallization from supersaturated solutions by means of hydrothermal processes or through the evaporation of the solvent from thin layers of concentrated solutions provided as droplets [31-33];
- **bursts of gas bubbles**, in sparging with air or other inert gases, through supersaturated saline solutions [34];
- **atomization of saturated saline solutions** in vacuumed cyclones, followed by physical dispersion using an air flux [35, 36];
- **engagement of superficial particles**, resulting from consecutive solvolyses and anhydrations of the surface structures, following the movement of air through orifices and channels in parallelepipedic blocks of rock salt placed along the walls of the halochamber [37-40].

Our team has elaborated four artificial halochambers, with static generatory systems using linen or hemp canvas impregnated with salt crystallites obtained through recrystallisation in warm-worked concentrated NaCl solutions, as such or in preset mix with KCl, CaCl₂, MgCl₂, and KI, or dynamic generatory systems involving niches allowing warm air ventilation through diaphragms that contain either salt slabs with multiple orifices, either salt granulates obtained through warm-worked recrystallisation from concentrated solutions [38-40].

Also, we have focused on the SPA systems with saline waters with concentrations between 200 and 300 g/L, which through the air sparging process leads to the explosion/bursting of the gas bubbles immersed at the surface, and issue fine solion particles into the atmosphere [41].

With this group of procedures, according to the diameter of the purging nozzle, correlated with the discharge rate of the ultra-hot air jet, and with the value of the sparging pressure, it is possible to obtain particles with preferential dimensional distributions for one of the four dimensional groups, respectively for solions.

Both the first group, that of the static halochambers (with self-generation at the external surface of the rock-salt slabs' walls), as well as dynamic halochambers (with continuous generation using a jet of air sent through porous salt diaphragms, which are reliable and adjustable solion levels) have been found to be very suitable for preventing and treating cardio-respiratory and osteo-muscular conditions, respectively for improving human performance.
in juveniles, the elderly and persons subjected to high physical stress.

Since the dynamics of the aerosols emissions inside halochambers is influenced by environmental conditions, the measurements were taken with the values of the pumped air parameters kept constant, and the microclimate formed inside the halochamber monitored for both regimens, static and dynamic. Table 1 presents the values of these parameters. Mention should be made of the fact that these experiments were carried out in artificial temperature and humidity conditions, as imposed by the static or dynamic work regimen.

The results obtained with the two halochambers allow the following conclusions:

- The experimental measurements in both halochambers were carried out 240 h after the instalment of the salt diaphragms, with firsts reads on the work and environmental parameters;
- The level of NaCl aerosols/solions for the static halochamber varied between 20 and 55 mg/m³, and for the dynamic one with vehiculation through slabs between 85 and 105 mg/m³, respectively with vehiculation through diaphragms between 125 and 140 mg/m³; the last offered a higher solion purity (29%) than the first (9%);
- The concentration decrease in time, for the static halochamber and in the stationary period of the dynamic one, is due to competitive processes: nucleation/condensation and peptization/coagulation, after which the decrease in concentration is slow, along a logarithmic scale, imposed by slow processes of accumulation and aging sedimentation.

The influence of the aerosols on human performance in juveniles

The experimental part used two cohorts of human subjects: one of reference in a sports hall and outdoor (depending on the environmental conditions), and, respectively, a study cohort inside a halochamber. Table 2 presents the differences between the two systems used in the experiments, with respect to the variation in the average characteristics of the microclimate factors for three years of study. The halochamber used was a school classroom with a volume of 180 m³, specially for this purpose with six Salin II units (SC Tehnobionic SRL, Buzau, Romania). The units were placed at the level of the windows, and operated between 7:00 AM and the end of the school day, during teaching days. The classrooms were used for teaching all the fields present in the curriculum, including physical education. The reference was, depending on the weather conditions, another classroom with the same volume, the sport hall and, respectively, an outdoor sports ground.

Organising the sport programme and selecting the classroom activities aimed the following:

- The harmonious physical development of the children (muscular system, the thorax, height, body strength and endurance, an equilibrium between the optimal weight and the height of the students);
- To improve and strengthen the students’ health, to harden the organism (fewer colds and shorter recovery times, improving the general work capacity, fewer students exempted from physical education and other disciplines);
- To develop the functional capacity of the organism by increasing the cardiovascular and respiratory potential (increase in the permeability and improving the dynamics of the pulmonary pleura) and of the general metabolism;
- To control breathing, its amplitude and rhythm through simple techniques and in combination with various games in order to relieve anxiety and psychological distress (balancing the psyche and eliminating emotional tensions);
- To raise the quality of the entire teaching activity, by means of good physical-physiological disposition towards learning and acquisitioning of knowledge.

<table>
<thead>
<tr>
<th>Work regimen</th>
<th>Parameter</th>
<th>Temperature (°C)</th>
<th>Relative humidity (%)</th>
<th>Atmospheric pressure (mmHg)</th>
<th>Illumination (lx)</th>
<th>Solion concentration (mg/m³)</th>
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<tbody>
<tr>
<td>Static</td>
<td>Halochamber with wall made of canvas impregnated with salts</td>
<td>18–23</td>
<td>60–80</td>
<td>756–770</td>
<td>80–120</td>
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<tr>
<td>Static</td>
<td>Halochamber with ventilation niche walls made of slabs</td>
<td>22–35</td>
<td>55–75</td>
<td>756–770</td>
<td>80–120</td>
<td>85–105</td>
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<tr>
<td>Dynamic</td>
<td>Halochamber with ventilation niche walls made of diaphragms with recrystallised granules</td>
<td>40–90</td>
<td>55–75</td>
<td>756–770</td>
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<tr>
<td>Reference room*</td>
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<td>P, atm</td>
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<td>I, lx</td>
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<td>112</td>
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<tr>
<td>Halochamber**</td>
<td>C, mg/m³, solion</td>
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<td>70.5</td>
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* Reference room — either the regular classroom, with a volume of 180 m³, the sports hall, or, respectively the outdoor sports ground (depending on the type of teaching activity and weather conditions).

** Halochamber — a classroom fitted with six Salin II units.
For reaching these goals, across different age brackets, there were selected from the teaching plan only those exercises that allowed a better harmonisation of the structural and functional biometric characteristics [42-45], including:
- walking (variants), running (variants), jumps (variants), exercises for all body segments (with and without objects, with and without background music) - the first 20 min;
- sport games (football and basketball for boys; handball and volleyball for girls) - the next 20 min.

For the functional developments in correlation with the physical effort, the following exercises were performed: body-weight squats in girls, and chest push-ups for boys; the exercises were counted and timed. These exercises were perfumed gradually, from the point of view of the effort exerted. The students who worked inside the halochamber came into contact with the solion atmosphere, both at the level of the skin (having been dressed in shorts and t-shirts) and through inhalation.

After the primary data were recorded in a table system, they were processed and the time evolution of the morpho-structural (weight, height, chest size) and functional (lung capacity, blood pressure and pulse) were represented graphically, for each group of students, along three age brackets and for each sex.

For all age series, the girl reference-group had a smaller increase in height than of the boys in the halochamber, with the girls having a slower growth rate than the boys.

The experimental data obtained for the two student cohorts registered continuously for a period of three years led to the following conclusions:
- The graphs of percentage evolution of all biometric characteristics studies reveal a more pronounced growth in the case of girls than of boys, for the halochamber group in comparison with the reference group, even though the two curves for girls are sometimes found under the growth evolution curves of the boys;
- The evolution of the morpho-structural (weight, height, chest size) and functional characteristics (lung capacity, blood pressure and pulse) in all age series, was more strongly influenced in the case of girls than boys;
- The evolution of the teaching activities concerned only two aspects: the semester averages of the students’ absences, and the semester averages for the academic grades. A higher absence rate was registered for boys than for girls, with the former absenting more in the springtime semesters than in the autumn ones, which can be explained by social aspects in the rural milieu in which the students live. Nevertheless, the students that worked inside the halochamber had much fewer absences than those working outdoor.

The action of solitons on on the human organism

The NaCl ions are absorbed at the dermal level in corresponding ratios, and then reach both the lymphatic system and the cells, through two ways: diffusion and osmosis - the processes by which living cells procure minerals, proteins, lipids, sugars, and water [16-19, 42, 44, 45].

Diffusion represents the natural process of equilibrium of either two different pressures or two concentrations with different values, and results from the random movement of molecules inside and around cells. Osmosis is the phenomenon of transmitting various substances through a semi-permeable membrane, specifically the cellular membrane. Both processes take place on the basis of natural physical-chemical laws, without energy expenditure or mechanical work [42]. Osmosis and diffusion are vital processes through which living cells feed with various nutrients and water.

Molecular and cellular studies on animals have shown that the reabsorption of the fluid inside the distal aerial spaces of the lung is a phenomenon directed by an active transportation of sodium. Several in vivo, in situ or on isolated lung tissue have identified catecholamine-dependent mechanism, as well as other independent mechanisms that model the transportation of fluids through the activation of Na, K-ATPaze pumps, or by increasing atypical uptake by opening water channels (also called aquaporins, of 30 kDa). For this reason, interventions seeking to change the osmolality of the periciliar bronchial fluid can have important consequences on the local homeostasis and the proper functioning of the lung [43].

In an extremely rigorous study, Anderson et al. [46] compared the effect of inhaling 4.5% aquated NaCl aerosols with that of inhaling them in the form of dried powder, in various quantities of 5, 10, 20, or 40 mg/capsule. The results were superposable and reproducible, and concluded that dried powder can substitute NaCl in the form of aquated aerosols (solution) in test of triggering and assessing bronchitic hyperreactivity, with the permeability measurable foremost by the magnitude of the bronchoconstriction at the moment of inhalation and then by the toxicity of the aerosol, in the sense that hypotone solutions reach deeper in the respiratory ways.

Numerous studies have supported the view that hypertone NaCl (4.5%) aerosols induce bronchitic hyperreactivity, for which reason they are used in therapy for triggering tests alongside histamine and methacholine; for other authors still, these aerosols have an even greater specificity and predictive value than other substances [47-49].

Nevertheless, it is known that non-isotope aerosol concentrations, either hyper- or hypo-tonic, by changing the osmolality of the periciliar fluid can precipitate a bronchospastic crisis [50], with evidence that the change in the osmolality of the fluid inside the airways causes the release of mediators from bronchitic inflammatory cells, but that the isotope aerosols do not have pemicious effects.

Chernova et al. [50] have shown the potential of saltmine speleotherapy to lower microbial (particularly staphylococcii) contamination of the upper respiratory tract in children with respiratory allergy. This bactericide performance can be explained through the complex immunomodulatory effects induced by the procedure: the increase in the number and the activation of the T lymphocytes, the normalising of the number of B lymphocytes, the increase of the IgA level [51].

A. Abdullaev, K. Gadzhiev and A. Eiubov [52] experimented on 216 children with atopic asthma the effect of halotherapy in diminishing the obstructive syndrome; later on, other researchers [53] showed on a cohort of 18 patients with bronchitic asthma the effect of lowering bronchitic hyperreactivity following halotherapy. In the same period, another group of researchers [54] highlighted that the NaCl aerosols, dispersed in the atmosphere as dried powder, have therapeutic effect at concentrations of 1–5 mg/m^3.

Exposing human subjects to halotherapeutic atmosphere has no contraindications, for prescribed exploitation conditions, but it is nevertheless necessary to know the level of physical development and the health of the subject:
- For healthy or seemingly healthy persons, exposing the organisms to saline atmosphere for ca. 30 min per day is beneficial for maintaining physical tonus and positive mental attitude;
- For obtaining results with respect to the prevention and then the mineralisation of the organism, a cure of 12–18 days, 30 min/day, can be held cyclically each month or when necessary.
- For treating light colds - as a complementary treatment, between 30 and 60 min per day, for at least 12 days;
- For asthma sufferers, depending on the degree of manifestation and the health state, between 1 and 4 h per day, in a cure lasting 14–21 days, that can be repeated cyclically, with a rest period of approximately 14 days or as necessary;
- For various respiratory conditions, according to the degree of manifestation, between 30–60 min and 2–4 h per day, in a cure of 14–21 days;
- In preventive cures, particularly during season change periods when the organism is predisposed to sickness - between 30 and 60 min per day, for at least 12 days;
- In remineralisation, maintenance, relaxing, recovery, and prevention cures, between 30 and 60 min per day, anytime possible, but not less than 30 min./day [55, 56].

The airways are kept moist by the mucus produced by the mucous cells from the epithelial layer of the respiratory tract, and partially by submucosal glands. The mucus film captures small particles from the inhaled air, preventing them from reaching the alveoli. The mucus film is constantly being produced, on account of the dynamic ciliary movements at the level of the respiratory epithelium.

The inhaled air reaches the lungs at ~1.0°C warmer than at inhalation, as it is warmed and humidified by the nasal cavity. The saturation in water vapours and the presence of the mucus make possible the action of the superficial tension forces at the level of the upper respiratory ways through the action of Starling forces [17–19].

The pulmonary surfactant is a complex phospho-lipoprotein secreted by the type II alveolar cells, specialised epithelial cells, granular in terms of appearance, with lipidic inclusions, which occupy approx. 10% of the surface of the pulmonary alveoli [17–19].

The presence of water in the pulmonary alveoli renders them prone to collapse and thus push the air out of the lungs. The molecule of the pulmonary surfactant - just as other cellular membrane constituents - having a hydrophilic and a hydrophobic head, serves as the air-water interface and increases the pulmonary compliance [14, 18]. Pulmonary ventilation, respectively the continuous refreshing of the air in the exchange pulmonary areas, where there is also a direct contact with the capillaries, is a consequence of the pulmonary compliance and the presence of the surfactant. In the course of one breathing, only a small part of the inhaled air entering the lung reaches the terminal bronchioles. The alveolar air is ventilated through diffusion, being the result of the dynamic movement of gas molecules. The same phenomenon is involved in the path followed by the sodium and chlorine ions up to the level of the alveoli. Sterling forces equilibrium is achieved through the intervention of the Na+ ion, which attracts water from the interstitions and increases its quantity in the alveolar space. This phenomenon has the immediate effect of augmenting the sol phase of the surfactant, and accelerating the mucociliar clearance [19].

Under the action of the Na+ ions, the cilia improve their functioning by its presence in membrane depolarising and, implicitly, in increasing the activity. Thus, by improving and augmenting the ciliary function, the Na+ ion inhaled during halotherapy increases the mucociliar clearance and ensures a more efficient cleaning of the upper and lower respiratory ways [13].

Furthermore, in the case of smokers, where ciliary movement is known to slow to a halt, the Na+ ion is able to reactivate the release and clearance of the mucus, followed by relieving the respiratory tree by activating the cilia [19]. Therapy in natural or artificial halochambers has other beneficial effects, including: improving expectoration by increasing the volume of sputum and secretions inside the upper airways - this leads to an improved respiratory activity and respiratory relief for the patient, further causing a more productive cough; obtaining, in time, a bacteriostatic effect by reducing the episodes of recurrent infections of the respiratory tract, or the complete elimination of seasonal acute disorders (it is beneficial for chronic obstructive pulmonary disease patients, for whom a respiratory infection episode can be fatal); improving the quality of sleep by reducing edema of the upper aerodigestive tract (the soft palate, base of tongue, palatine tonsils) often found in snoring sufferers [13].

Conclusions

The papers presents the results obtained during the last years in obtaining and the chemical and physico-structural characterisation of saline aerosols nanodispersed in media for prevention, therapy and fresh air. As such, the levels of dispersion in the trimodular system (Aitken, medium and large/coarse or sedimentable) are analysed. In the first granulometric distribution of the Aitken particles, two subgroups can be distinguished: that of hydrated particles, known as solions, and, respectively, that of anhydrous particles, in the form of weakly superficially hydrated nanopolyhedrons.

The solions are dynamic particles, with a mutable glomerular structure, which at the level of in vivo tissue allow through deliquescence the directing of ions towards specific channels, activating biochemical processes. Conversely, the nanopolyhedrons, being strongly hydrophilic, will acute any condition through strong dehydration.

On the basis of ethnoarchaeological data, halotherapy advanced from the use of saltmines and beaches along saline waterbodies, to the production of artificial halochambers or of surface, which have multiple advantages in terms of control, regulation and monitoring of the concentration level, of the speed of formation, of the stability of the saline aerosols, and of their compatibility with other synthesis aerosols specific for prevention and treatment.

In this respect, two types of artificial halochambers are presented, viz. static and dynamic, with their main characteristics, alongside novel data concerning the influence of saline aerosols on the development of juveniles (secondary school students), obtained by our team. Prominent among the finds is that females are more receptive to the saline aerosols.

Finally, the mechanism of the processes of the solions’ actions on the human organism, by correlating the data obtained from specialised literature with the results of our team.

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