

Air ionization - an environmental factor with therapeutic potential

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ABSTRACT: Environment is characterized by a significant number of physical parameters, among which is the air ionization. It is also important under biomedical aspect, because it exercises the beneficial influences of living organisms. In the introductory considerations, the paper presents some theoretical details of how air ions are generated naturally and are mentioned some biological effects produced by ions (especially by artificial ionization), the most important from therapeutically point of view. Then, are presented the measurement methods of this electrical component of the ambient air and some ion concentrations from different places, but also in some balneary-climatic resorts from Romania. In the final part of the paper are mentioned the conclusions, as well as some new possible explanations (based on quantum theory) on how the air ions act on living organisms.

KEY WORDS: air ionization, measurement, spa resort, effects.

1. Introduction

Physical factors describing the surrounding air environment are very diverse (meteorological, climatic, physical, chemical etc.). Physical ones include those of electrical nature as electrical conductivity, electric field, electrical potential gradient, lightning, air ionization, atmospheric (Chalmers, 1967; Challenger *et al.*, 1996).

They occupy a special place, especially the ionization of air, because they have important therapeutic valence (Cupcea S. *et al.*, 1959, Flory R. *et al.*, 2010).

Although the first observations on the existence of air gaseous ions have been made since the 1930s, only subsequent research (since the 1950s in many scientific groups) has highlighted the link between the ion content in the air (small ions mainly) and the health of the organisms, but also with the pollution of the respective ambient atmosphere.

As evidence of the importance of these electrical components of air for living organisms is also the fact that, in the absence of atmospheric ions, living organisms cannot exist and any reduction in atmospheric ions (especially those with negative polarity) from the work places, rest and treatment, home, etc. is a cause of disturbances of the health of the body and the appearance or amplification of pathological conditions (Krueger, 1972; Enache, 1999).

In this respect, a large number of researches confirm the existence of the link between this electrical parameter of air and a series of biological effects manifested at different stages of organizing the living world, from the cellular to the body (Badre, 1972; Breton and Breton, 1994).

In view of these findings, it is concluded that it is absolutely necessary to know and highlight the characteristics of natural air ionization from different environments, but especially of areas for therapy, recreation and rest (generally wherever human activity is present), because this environmental factor has influences and effects that can be beneficial to the body, which can be used for both therapeutic and tourism purposes (Sulman et al., 1977; Ogungbe et al., 2011).

1.1 Theoretical considerations

In theory, the generation of ions in ambient air is explained by the action of several physical factors on air molecules.

Among the main generator factors are the radioactive elements in soil and air, as well as cosmic radiation that, by corpuscular radiation (α , β) and electromagnetic waves (UV radiation), emitted, directly or indirectly (through disintegration suites), provide the energy necessary to ionize the neutral air and water molecules in the atmosphere. The negative influence is due to the degree of air pollution, because the higher the pollution, the lower the air ion concentration.

The ionization process of the air molecules is complex and takes place in several successive stages (Chalmers, 1967).

Finally, these processes which take place in the atmosphere, involving energy exchanges between electrons, water molecules, and other ionic species, lead to the ultimate generation of hydrated air ions of the form: $H^+(H_2O)$, $(H_3O)^+(H_2O)$, $O_2^-(H_2O)_n$, $OH^-(H_2O)_n$ and others.

Among the secondary ionizing agents are those on water fragmentation processes (microparticle breakage, fine jet spraying, breakage of air bubbles from the surface of the water, ionic evaporation), which have local particular importance. The ionic polarity depends on its chemical composition, breaking of ice crystals by collision and others, physical processes and phenomena known in meteorology (passage of atmospheric fronts). Some of them, for example, are on the seashore (rough sea waves or foamed ashore), in the vicinity of waterfalls or artesian fountains, a harsh mountain river, during rain, blizzards and others.

The types of ions existing in the free atmosphere differ greatly in terms of physical properties (dimensions, electrical charge, mobility) and their evolution of concentration (daily and annual) in the environment depends on: (energy) intensity of the ionizing agents, local meteorological/weather conditions and their change, the degree of pollution of the atmosphere, the physical, geological and geographic characteristics specific to the place of measurement etc.

1.2 Biological and therapeutic effects of air ionisation

The presence of air ions in the environment quickly attracted the attention of biologists, physiologists and doctors, since the beginning of last century. On this occasion, the opinion was also expressed that, their favourable influence on the state of health, is explained in addition to the specific factors of the cleaning environment, and by the ionization of the respective air.

These influences are possible because a significant number of phenomena of an electrical nature, with a biologically and physiologically essential role (e.g. biochemical reactions, transmembrane transport of substance, propagation of the nervous influx and others) are manifested in the living organisms, which react also to the influence of an electrical (or magnetic) factors.

The excess of negative electric charges carried by the ions interact with both sensory nerve endings in the alveoli, as well as a number of blood components (red blood cells, some colloids), modifying the property and electrical stability thereof and influencing indirectly other properties of various organic structures, by means of numerous biochemical reactions, which contribute to the intensification of metabolism.

Numerous studies and research conducted to date indicate the existence of a large number of biological and therapeutic effects (Cupcea *et al.*, 1959; Deleanu *et al.*, 1962; Bachman *et al.*, 1965; Straus *et al.*, 1968; Assael *et al.*, 1974; Estola *et al.*, 1979; Dautzler *et al.*, 1983; Aionesei and Anîței, 1986; Mitchell and King, 1994; Alexander *et al.*, 2013; and many others, see references).

Thus, the most important influences include, very briefly: *the physical-chemical properties of the blood* (decrease of VSH, increase of colloidal stability of blood serum proteins, decrease of albumin-globulin coefficient due to the increase of the amount of globulins, change of blood pH to alkaline, decrease of the amount of sugar, decrease of lactic acid accumulation, decrease of 5 - hydroxytryptamine level and others), *cardiovascular system* (decrease of blood pressure and number of cardiac pulses), *neuro - motor system* (decrease of motor nerve chronax, influences on the functional state skeletal muscle, decreased overall body reactivity, EEG effects, headache loss, dizziness, insomnia, etc.), *respiratory system* (intensification of gaseous exchanges, ameliorating of bronchial asthma, slowing breathing rate and increasing breathing breaks), *the skin* (calming burns pain, favouring wound healing, improving the body's defence response and increasing resistance to acute and chronic infectious diseases), *endocrine system* (regulating effect, stimulation of vitamin formation and their accumulation in the blood).

Add to this, *the general effects* (increased appetite and thus weight gain, increasing thoracic volume, improve human performance, organisms become calmer) and *bactericidal effects* (decreased toxicity and delayed development of bacteria, acceleration of microbial death, decrease of wound microflora).

The therapeutic contraindications are very few and refer to situations rarely encountered in current biologic practice or only to excessively high concentrations of ions.

Positive air ions often have actions and effects opposite those produced by negative ions (negative effects, unpleasant feelings of subjects due, for example, to serotonin release).

In fact, knowing the positive valences of air ionization led to another applicative aspect, namely, the use of artificial air ionization (more efficient and better controlled than the natural one) which has found a wide spread, especially in the West, but, unfortunately, close to place in Romania.

2. Methods

Environmental determinations aimed at determining the natural concentration of the air-ion, its polarity (positive and negative), as well as the unipolarity coefficient – k (which gives better indications of the electrical weight of the air-ionization regime at the considered locations).

Older measurements were made by classical method based on the discharge of a cylindrical electric capacitor under the action of a controlled air flow. These experimental determinations

were made with an Ebert type ion counter, equipped with a Leybold biphilic electrometer, without an auxiliary field, coupled with an air aspiration device.

Then, an electronic ion counter (based on the same principle), but more performant (Alpha Lab Inc. – U.S.A.) was used for the recent years. The accuracy of determinations was of ± 10 ions/cm³.

In addition to natural ionization, through various types of artificial ion generating apparatus can be obtained (in limited spaces) concentrations of ions both polarities with very high values, reaching several million ions/cm³ (Chang *et al.*, 1991). They are used for both research and air-ion therapy.

3. Results

For most of the localities, under conditions of good weather, the natural ionization of the air is only slightly preponderantly positive (about 20-25% more than the negative ions), because at such a time the terrestrial surface usually presents, a negative polarity to atmosphere and clouds, which has a positive electric charge (the so-called "electrode effect" according to the theory of the atmospheric electric capacitor).

The action of the generating factors is countered by the influences of some factors that lead to the ion's recombination (eg. air pollution), which leads to the establishment of a certain balance of the ion content in the air, reflected in the existence of a certain ionization regime air at a time and place. For example: near a waterfall $\sim 50,000$ ions/cm³, in the mountains (high mountains) $\sim 4,500 - 8,000$ ions/cm³, In some spa resorts $\sim 3,000 - 4,000$ ions/cm³, in town < 500 ions/cm³, extra-urban areas $\sim 500 - 1,500$, typical modern office (medium) $\sim 100 - 350$ ions/cm³ (Chalmers, 1967).

This air-electric regime, especially the predominantly negative, have, moreover, been the fame of not only some spa resorts in France (Biarritz) and Germany (Bad Gastein), but also other (often wooded) areas where they are located, for example, some nursing homes for adults or children.

Over time, numerous measurements of natural air ionization in some localities but also in balneary-climatic resorts were made in Romania since the first half of the last century by Herovanu M. (1939) and later by other researchers such as Deleanu M., Cupcea S., Grigoriu H., Frimescu M., Crețeanu V., Pascu S., Enache L., Bunescu Iulia and others (table 1).

In most of the balneary-climatic localities where natural air ionization determinations were made, it exceeded total concentrations of 1000 ions/cm³, much higher than in cities. In some of them (Balványos, Felix, Slănic Moldova, Predeal, Vatra Dornei) there were even subunit values of the unipolarity coefficient, which shows that the atmosphere of these places is favourable for the health of the organism. An air with a higher negative ion content gives a character not only more salubrious for the environment, but also with other therapeutic valences (the air-logical action of aeronautics starting from the pulmonary and tegumentary level - to a lesser degree) – as shown above.

Table 1 The values of the air ion concentration (n^+ , n^- , n) and the unipolarity coefficient ($k = n^+/n^-$) in some spa resorts in Romania.

The spa resort	n^+ (cm^{-3})	n^- (cm^{-3})	n (cm^{-3})	k
Balványos – Turia	703	762	1465	0,92
Felix	664	674	1318	0,96
Herculane	589	636	1225	1,00
Olănești	1026	901	1927	1,14
Tușnad	772	633	1405	1,21
Călimănești-Cozia	511	464	975	1,10
Moneasa	622	607	1229	1,02
Slănic Moldova	458	462	920	0,99
Eforie Nord	478	425	903	1,12
Predeal	721	775	1496	0,93
Vatra Dornei	619	646	1.265	0,96

In some of these locations (Herculane, Felix) geological structure and thermal water are known to contain radioactive elements. In other places (Olănești, Predeal), vegetation or altitude favour a higher concentration of ions in the air.

Although these data are only "samples" of the natural air ionization regime obtained by episodic determinations (in different seasons of the year and in various meteorological conditions), however, they are absolutely necessary for the assessment and supervision of the framework of recreational activities, rest and treatment, especially in the context of infrastructure changes and the urbanization trend of these localities.

In the situation where the ion concentrations from the atmosphere of the resorts are relatively high and show a certain differentiated distribution of atmospheric ions (especially with a higher content of negative ions) they can act even as a therapeutic factor, favourable on living organisms.

Regarding the mechanisms of action of air ionization, we consider that, in short, the old biological and physiologic explanations (electro-humoral or neurological theories) need to be rethought and looked deeper, going on a *quantum level*, because, in essence, electron exchanges cause energy fluctuations in atoms and molecules, influencing some structures, properties and functions important to vital processes.

4. Conclusions

Observations on natural air ionization at sites under consideration (used for treatment, recreation, rest and tourism) are different, depending on the area characteristics.

Higher values (higher than in the cities), show the air-electric potential of these areas, the importance and the climatic-therapeutic capacity of air ionization, the need to preserve these characteristics for their inclusion and medical use, along with other valuable specific factors of the investigated curative areas.

Permanent assessment of the framework for recreation, rest and treatment is required, especially in the context of infrastructure changes and the urbanization trend of these localities.

Starting from the research of the natural air-electric status of the spa resorts and from the favourable results obtained in the scientific research so far, artificial air-ionization has been used in spaces dedicated to this therapy (treatment rooms, underground facilities, saline etc.), as well as new investigations to update the existing air-ionometry information fund in the present and to allow a better quantum understanding of the effects of this physical component (electric) environment having significant biological meanings.

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