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Solion - A Bioactive Nanostructured Particle

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Abstract

The paper presents a series of data on the anionic nanostructures of hydrated halo salts, obtained in situ in the process of generating Aitken particles from the fluorescence of hot recrystallized granules from aqueous solutions of super-saturated mixtures of alkaline and alkaline-earth halides. In humid atmospheric environments (≥80% RH), from halo-salts nanocrystals, glomeruli with concentric structure formed by water pentahydrols and low ion packing nanopolyhedrons, involving a mechanism with three-stage kinetics, with different speed constants. Depending on the doping system of the NaCl hooks with other alkaline and alkaline earth halogens, a series of halochambers has been developed with multiple practical applications, such as: prevention and therapy of cardio-respiratory, osteo-muscular and psycho-motor disorders, as well to improve the physical performance of children, the elderly and people who work in high effort conditions or performance athletes.

Keywords: Aitken Particle; Nano Aerosol; Saline Nano-Aeroanion; Glomeruli; Lifespan; Coordinated Aquatemplation; Pentahydrols; Halochambers; Prevention and Therapy

Abbreviations: NaCl: Sodium Chloride; $(H_2O)_5$: Pentahydrols of Water; $CaCl_2$: Coliseum Chloride; $MgCl_2$: Magnesium Chloride; KCl: Potassium chloride

Introduction

The saline aerosols in the form of nano dispersions in gaseous environments, behave, regarding the concentration levels and the lifetime, as trimodal Gaussian distributions, in the form of fine particles - Aitken type, with diameter below 50 µm, averages, between 50 and 500 µm and respectively, rough or large, between 500 and 1000 µm [1-7]. The latent generation depends by the active surface of the source (number of generating centers, size and position of fluorescence, porosity, size and structural profile of the source etc.), by climatic parameters, but also several other characteristics of the gaseous environment [3-13]. Within our group [3-5,14-23] it has experimentally demonstrated that hydrated saline aerosols, solion type, as such or doped with other halo-salts, in addition to the ability to prevent and treat cardio-respiratory, osteo-muscular and psycho-motor disorders, have at certain levels beneficial concentrations on the development of children, as well as a decisive role in increasing the athletic performance in young sportsman and improving the resistance to the physical effort of the people who carry out intense activities, in high effort conditions or performance regimes.

This paper presents the mechanism of formation for solions, the structure in the form of stratified spherical cluster and the six groups of practical applications developed in our collective.

The mechanism of formation of solions

Based on our research [3-5,14-23], we have developed a series of halochambers, based on the principle of operation the process of differentiated or concomitant generation of solions from five types of salts (NaCl, KCl, KI, $CaCl_2$ and $MgCl_2$), depending on the value the stability constant for a certain stratigraphic profile of the reformulated glomerulus (the interaction between low-packing nanopolyhedrons and water pentahydrols present in the gas dispersion). Thus, when transporting hot and humid air through the porous structure of the thin layer with micro crystallites of weakly bound halo-salts, matured by recrystallization from supersaturated solutions, the nanopolyhedrons with low packing dispersed in the hygroscopic gas environment, in the presence of the water pentahydrols present, it is reformulated by aquatemplates in concentric, movable stratified structures. At the base of the in-situ reformulation processes of the solions from anhydrous or poorly hydrated nano-crystallites recently generated by porous microgranules, is based on the mechanisms of superstructure through coordinative aquatemplation with water pentahydrols of Na^+ cations and nanopolyhedrons with low packing of pairs of ions from halosalts. At the nanostructure level, they take multiple forms of mutable glomeruli, with concentric stratified spatial structures, like snowflakes. The structural order multiple [3-5] is accounted for by the compatibility between the cubic crystalline networks of halosalts (MX or MX_2) and water pentahydrol, $(H_2O)_5$. It is known that the generation of the five types of solions is subject to the equilibrium of the solid-liquid and solid-gas nanodispersions respectively, the formation of hydrated nano-particles being controlled by the solubility constant (reaching the saturation level in the solution) and electrostatic or steric stability/instability (from the ambient air of the halo-chamber). In such generation systems, solions differ from anhydrous or poorly hydrated Aitken nanoparticles, forming a Gaussian distribution module with dynamic extension of movable spherical glomeruli (with continuous structural reforming) consisting of a single pair of ionic species in different clusters of anhydrous nano-crystallites. The solutions of different salts can coexist as a stable nanodisperse system in a halo-chamber, due to the steric and electrostatic factors. Their lifetime is influenced by the presence of positive nanoparticles (aerogenes of an organic nature, for example: spores or those resulting by pyrolysis - cigarette smoke) and sudden changes in microclimatic parameters (humidity, temperature, pressure, illumination, presence of polluting smog etc.) [3-5,14-23].

Structure of the stratified spherical cluster solion

The solions are hydrated bioactive particles in the form of a cluster, reformulated in situ from Aitken-type saline nano-aeroanions, anhydrous or poorly hydrated, in humid atmospheric environments, in the presence of restructured water pentahydrols. In the form of semi-stable gaseous nano dispersions, they have a concentric layered structure, composed of nano-polyhedrons with low packing of ion pairs and water pentahydrols. They are covered by a monomolecular layer of aqua dimers, which give them a superficial negative charge, with typical aeroanion behavior. It is a highly hydrated concentric stratified nanocluster, continuously reformed (dynamically) in gaseous environments, with the partial preservation of the superstructure of the solved ions [$M_{(aq)}^+$ or $M_{(aq)}^{2+}$ and $X_{(aq)}^-$], of the MX and MX_2 nanoplyhedrons, and water pentahydrols, in the form of highly symmetrical stratified movable structures and with a negative subunit electrical charge (which gives them aeroions-negative behavior). It has the chemical formula $[x(MX/MX_2)_{2n}{\cdot}y(H_2O)_5]_{(aq)}^{q-}$, in which x and y represent the combination ratio between halosalts nanopolyhedrons and water pentahydrols, where n varies between 2 and ca. 4100 (4 × 1024) and q ≤ 1 [3-5].

Practical applications of solions

The literature of the last 20 years [24-38] presents a series of applications, which have been in the attention of our team.

The following is a brief overview of a number of multiple applications [39-46], such as: prevention and therapy of cardio-respiratory, osteo-muscular and psycho-motor disorders, improving physical performance in children, the elderly and persons working in conditions of high effort or high performance athletes and soon to eliminate or stop the formation of biofilms by microbiological (virotic, bacterial, fungal, etc.) contamination of the biometallic and/or bioceramic systems of the removable/non-removable prosthesis for bones and teeth. Through reversible recrystallization/deliquescence processes, the solion allows good bioactive compatibility with tissues, stimulating a series of in-vivo membrane processes, which allow both the prevention and treatment of the conditions listed above.

Over the last 10 years, our team has experimentally demonstrated and developed a series of cameras for six groups of practical applications presented in Table 1.

Application	Medical domain	The level in solions in the halochamber (mg/m^3)	Composition of microgranules * (g/L)	Working mode of the device for generating solions**
1	Prevention and treatment of respiratory (airways) disorders	>80	NaCl = 280-300 g/L	a – 73 - 75°C; b – 0.8 – 0.9 atm; c – 1,1 - 1,2 atm; d – 55 - 60°C; e – 75 - 80%UR f – 72 h
2	Treatment of high blood pressure	>100	NaCl = 250-280 g/L, KCl = 380-400 g/L, $MgCl_2$ =320-350 g/L, The ratio: NaCl:KCl:$MgCl_2$ = 8:1:1	a – 73 - 75°C; b – 0.8 – 0.9 atm; c – 1.2 – 1.3 atm; d – 55 - 60°C; e – 75 - 80%UR f – 54 h
3	Thyroid gland disease therapy	>120	NaCl = 250-280 g/L, KI = 130-150 g/L, The ratio: NaCl:KCl = 9.5:0.5	a – 73 - 75°C; b – 0.8 - 0.9 atm; c – 1.2 - 1.3 atm; d – 55 - 60°C; e – 75 - 80%UR f –
4	Treating neuro-motor disorders and improving physical performance in children, the elderly and people working in high effort conditions	between 10-60	NaCl = 230-250 g/L, KCl = 380-400 g/L, $MgCl_2$ =320-350 g/L, $CaCl_2$ = 420-450 g/L The ratio: NaCl:KCl:$MgCl_2$:$CaCl_2$ = 8:1:0.6:0.4	a – 73 - 75°C; b – 0.8 – 0.9 atm; c – 1.1 – 1.2 atm; d – 50 - 55°C; e – 55 - 60%UR f – 48 h
5	Improving the performance of young athletes	between 6-10	NaCl = 250-280 g/L, KCl = 380-400 g/L, $MgCl_2$ =320-350 g/L, KI = 130-150 g/L, The ratio: NaCl:KCl:$MgCl_2$:KI = 8.5:0.85:0.6:0.05	a – 73 - 75°C; b – 0.8 - 0.9 atm; c – 1.1 - 1.2 atm; d – 50 - 55°C; e – 55 - 60%UR f – 48 h
6	Preventing or stopping the formation of biofilms on the surfaces of prostheses for bone and teeth implants	>80	NaCl = 280-300 g/L	a – 73 - 75°C; b – 0.8 – 0.9 atm; c – 1,1 - 1,2 atm; d – 55 - 60°C; e – 75 - 80%UR f – 72 h

Table 1**:** Applications studied within our group [39-46].
*Microgranules are obtained by hot recrystallization from supersaturated aqueous solutions, followed by loading in dried air diaphragms with humid and warm air vehicles for dispersion in halo-chambers; ** Working mode of the device for generating solions in the halo-chamber: temperature (a) of the supersaturated aqueous solution, depressurization (b) on drying with dried air, the dispersion of the nano-crystallites from the surface efflorescence by blowing (c) hot air (d) and humid air (s), the minimum life time of the solion (f).

The scientific literature [47-54] presents a series of formulations of the structural profiles for nanopowder, bioceramic, nano-tubes and other non-toxic nanoparticles with implications in prevention and treatment, which have characteristics for 3D or 2D structural sequences of continuous, integrated and solid phases, but not as a dynamic particle dispersed in the moist gas phase, such as the solion, whose in-situ formation and in-vivo behavior is totally different.

Two papers [55,56] which attracted the attention of the authors, after 2003, in which the term solion was used, attributed to an integrated microstructure to the solid phase of electronic components, which was not protected as a trademark or patent, over the years and it was abandoned at the expense of other forms of presentation. Starting with 2003, in order to explain the formation mechanism and the in-vivo involvement mechanism at the membrane level, the authors adapted this term, as having full coverage for a movable nanoparticle, with the stratified concentric structure, consisting of water pentahydrols and halosalts nanopolyhedron, based on the effect of super-structuring by coordinating aquatemplation of the cations from the nanopolyhedron peaks.

Conclusion

The paper presents a series of data, with a high degree of novelty, obtained and published over the past 15 years by our collective, namely:

- The theoretical and experimental foundation of the solion.
- A concentricly stratified glomerular nanoparticle, with a continuously reformable structural profile, composed of MX and/or MX_2 nanopolyhedrons (in which M^+ - Na^+ and/or K^+; M^{2+} - Mg^{2+} and/or Ca^{2+}.
- (X^- Cl^- and/or I^-), and pentahydrols of water, $(H_2O)_5$, of the chemical formula $[x(MX/MX_2)_{2n}\cdot y(H_2O)_5]_{(aq)}{}^{q-}$, in which x and y represent the combination ratio between nanopolihedra of halosars and pentahydrols of water, where n varies between 2 and approx. 4100 (4×1024) and $q \leq 1$.
- Explanation of the superstructure of solions by the process of coordinated aquatemplation of the pentahydrols at the metal cations from the peaks of the nanopolyhedrons.
- Development of six types of halochambers, with systems for generating solions, differentiated by practical applications (prevention and treatment of airway diseases, treatment of hypertension, therapy of thyroid gland, treatment of neuro-motor disorders and improvement of physical performance in children, elderly and people working in high effort conditions, improving the performance of young athletes and preventing or stopping the formation of biofilms on the surfaces of the prostheses for bone implants and teeth).

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