Moussa. Chromatogr Spectrosc Tech 2017, 1(1):1-2
DOI: 10.36959/326/765 | Volume 1 | Issue 1

Chromatography and Spectroscopy Techniques

Editorial Open Access

Changes at the Surface Electrostatic Activity is Involved in Infectivity and Elimination of Accumulated Prion Proteins

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Abstract

The results obtained during the study of mutations on the gene coding for the human prion protein showed that the only major consequence of mutations is the perturbation of the protein surface electrostatic potential which subsequently is responsible for the convergence of PrPc to PrPsc. Streptomycin interacting with the prion protein induce electric charge changes on the prion protein surface leading to loss of infectivity as well the formation of small aggregates. Also, the application of electric current at different brain regions resulted in a probable interference in amyloid deposition. So, the application of static electric field and the inoculation of streptomycin associated to a peptide carrier can be helpful for inactivation and elimination of the accumulated prion protein during combating the prion diseases as well the other amyloidosis.

Electrostatic environment in a protein depends on the location and percentage of polar and charged residues forming short-range interactions, like salt-bridges and hydrogen-bonds which regulate the electrostatic properties. Thus, electrostatics participate mainly in protein binding, thermal stabilities, molecular recognitions, conformational adaptabilities and protein movements. The high affinity binding of monoclonal antibodies frequently involves electrostatic interactions with their antigens [1].

Static electric field was used *in vitro* to disintegrate distinct fibrillar beta-sheet aggregates of human serum albumin. This was possible via disruption of the electrostatic interactions that hold the serum albumin fibrils together [2]. Appling a unilateral Electroconvulsive Therapy (ECT) to the brain of an 82 elderly positively diagnosed Alzheimer disease woman had resulted in a complete clearance of the accumulated beta amyloid protein in that brain side compared to the non-treated brain region. This result suggests that ECT might interfere with amyloid deposition *in vivo* [3]. Recently pulsed electric current was applied at different human brain regions as therapeutic application for certain neurological disorders as for Parkinson's disease, focal epilepsy and psychosurgery. Finally,the application of the electric field in cases of brain cancers prevents the normal mitotic process and causes cancer cell death prior to division without harming healthy cells.

Prion diseases developed usually after conformational changes of a native cellular protein resulting in its transformation to a pathogenic amyloid protein which accumulated intracellularly provoking cellular degeneration and death. The Cellular Prion Protein (PrPc) and the Pathogenic Prion Protein (PrPsc) possess the same amino acid composition, but vary in conformity. Therefore, infectivity gains and resistance to proteinase K are a consequence of conformational modification of PrPc by PrPsc. PrPc contain about 40% alfa-helix and less than 10% beta-sheet conformation where PrPsc contain about 50% as a beta-sheet [4].

Guanidine alone and guanidine containing molecules as streptomycin have been shown to interact with either the prion protein or the Alzheimer peptide p53 leading to their aggregation [5]. The mechanism of interaction of streptomycin, as well as the other chemicals, possessing two guanidine groups with the prion proteins is most

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Received: April 25, 2017; **Accepted:** June 02, 2017; **Published online:** June 05, 2017

Citation: Moussa A (2017) Changes at the Surface Electrostatic Activity is Involved in Infectivity and Elimination of Accumulated Prion Proteins. Chromatogr Spectrosc Tech 1(1):1-2

likely to occur via hydrogen bond transfer between each of these chemical groups and the different negatively charged amino acids from the same or from different PrP molecules.

The addition of low concentrations of streptomycin to a PrPsc suspension result in attachment of the antibiotic to the 3 peptides isoforms leading to the increase of their molecular weight. Reticulation is expected when increasing streptomycin concentration was added due to cross-linking by such a proportionally small streptomycin molecule and the different PrPsc isoforms or fragments thus leading to formation of flocculated aggregates in liquid solutions [6].

Streptomycin interaction with the PrPsc induced electric charge changes on the protein surface leading to slight structural changes affecting the infectivity. As, the infectivity of the PrPsc was inactivated by adding guanidine alone [7] or streptomycin [8] without affecting the proteinase K resistance of the PrPsc indicating that infectivity and proteinase K resistance are dissociated.

Like streptomycin, the guanidine-containing compounds based on a benzene organizing platform and displaying between 2 and 5 arms have shown the higher anti-bacterial activity against tuberculosis *in vitro* [9]. The same bactericidal activity of streptomycin was also reported for bacteria present within the cell cytoplasm. As streptomycin can't pass through Blood Brain Barriers (BBB) and so cannot reach the different brain regions. Therefore, it needs a peptide carrier for allowing its passage through the BBB.

So, the formation of these hydrogen bonds and the accumulation of different aggregates alters the conformation of the PrPsc Leading to its destruction by cell machinery system. A combined action of streptomycin and the application of electro static current can disintegrate the accumulated amyloid aggregates within infected cells at different brain regions.

References

1. Pandey NK, S Mitra, M Chakraborty, et al. (2014) Disruption of human serum albumin fibrils by a static electric field. J Phys D Appl Phys 47.
2. Sinha N, Smith-Gill SJ (2002) Electrostatics in protein binding and function. Curr Protein Pept Sci 3: 601-614.
3. Vandenbulcke M, Bouckaert F, De Winter F-L, et al. (2015) Asymmetric Amyloid Deposition in the Brain Following Unilateral Electroconvulsive Therapy. J Biopsych 81: e11-e13.
4. Prusiner SB (1982) Novel Proteinaceous Infectious Particles Cause Scrapie. Science 216: 136-144.
5. Moussa A (2014) Two Functional Guanidine Groups Are Responsible For the Biological Activity of Streptomycin and Functionally Equivalent Molecules. J Chromatograph Separat Techniq 5: e126.
6. Moussa A, Coleman AW, Bencsik A, et al. (2006) Use of streptomycin for precipitation and detection of proteinase K resistant prion protein (PrPsc) in biological samples. Chem Commun (Camb) 9: 973-975.
7. Gao JM, Zhou XB, Xiao XL, et al. (2006) Influence of guanidine on proteinase K resistance in vitro and infectivity of scrapie prion Protein PrP(sc). Acta Virol 50: 25-32.
8. Moussa A (2014) Reduced accumulation of the prion protein (PrPsc) in mice spleen post inoculation with a mixture of the scrapie C506M3 strain and streptomycin. J Chromatograph Separat Techniq 5: 214-215.
9. Massima-Dibama H, Mourer M, Constant P, et al. (2015) Guanidinium compounds with sub-micromolar activities against Mycobacterium tuberculosis. Synthesis, characterization and biological evaluations. Bioorganic & Medicinal Chemistry 23: 5410-5418.