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A REVIEW ON AQUASOMES

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Abstract:
Aquasomes are circular particles made of calcium phosphate or ceramic diamond coated with a polyhydroxyloligomeric film that function as nanoparticulate carrier systems. Despite their simplicity, aquasomes are three layered self-assembled structures made up of a hard stage crystalline nanostructures core covered with oligomeric film with or without modifications in pH on which biochemically active molecules are adsorbed. The carbohydrate coating prevents the biochemically lively molecules from dehydration and stabilises them, while the solid centre core offers structural stability. Following the synthesis of the solid ceramic core and polyhydroxyoligomeric material coatings such as cellulobiose and trehalose, the final stage was drug packing, in which the aquasomes serve as host particles, non-covalently interacting with the bioactive moiety through hydrogen and cationic bonding. Insulin, haemoglobin, and enzymes such as serratiopeptidase have also been successfully delivered using the delivery mechanism. The concepts of self-assembly, method of planning, characterization, and implementation in various fields of pharmacy are covered in this article.

Index Terms: Method of preparation, Characterization, Application

1. Introduction:-

Multifunctional nanoparticles, quantum dots, Aquasomes, super paramagnetic iron oxide crystals, liposomes, niosomes, and dendrimers are some of the biomaterials used in nano biopharmaceutics. There are various forms of 'somes,' such as Aquasomes (Carbohydrates-ceramic nanoparticles), which are a nano-biopharmaceutical carrier device with a polyhydroxyl oligomeric film covers a particle core consisting of nanocrystalline calcium phosphate or ceramic diamond. [1, 2]. Kossovsky suggested a method for preparing nanoparticles that carry so-called Aquasomes, which have a particle size (less than 1000 nm) that is suitable for parenteral administration because it prevents obstruction of bloodstream capillaries. Aquasomes are furthermore named as "bodies of water." [3, 4]

Carbohydrates play an important role as natural stabilisers, as shown by the fact that fungal spores containing alkaloid can be stabilised by sucrose-rich solutions [5] and that desiccation-induced molecular denaturation can be prevented by certain disaccharides. [6]. Non-covalent bonds self-assemble these three layered structures. Three physiochemical processes control the principle of "macromolecular self-assembly." .i.e.

1) Interaction between charged groups [7, 8]: The interaction of charged groups promotes the long-range approach of self-assembly subunits. Exciting groups also aid in the stabilization of folded proteins' tertiary structures.

2) Hydrogen bonding and dehydration effect [7, 8]: Hydrogen bonds help to align base pairs and stabilise secondary protein structures including alpha helices and beta sheets. Hydrophilic molecules form hydrogen bonds, giving surrounding water molecules a large degree of organisation. Since hydrophobic molecules are unable to form hydrogen bonds, their ability to repel water aids in the organisation of the moiety in relation to its surroundings. Since structured water reduces entropy and is thermodynamically unfavourable, the molecule dehydrates and self-assembles.

3) Structural stability of protein in living environment: The interaction between charged groups and hydrogen bonds, which is mostly external to the molecule, and van der Waals forces, which is mostly internal to the molecule, determine the structure of the molecule. 7, 8, a hydrophobic molecule's hardness and softness, in addition to preservation of internal secondary structures, provides adequate softness and enables conformation to be maintained during self-assembly. Van der Waals must be buffered because self-assembly alters biological activity. Sugars aid molecular plasticization in Aquasomes.

1.2. Properties [9, 10]

1. Because of their large size and active surface, aquasomes can effectively load large quantities of agents using ionic, non-covalent, van der Waals, and entropic forces. Colloids are solid particles scattered in an aqueous environment that possess colloidal physical properties.
2. The surface chemistry of aquasomes regulates their mechanism of action. Aquasomes deliver content using a combination of targeted delivery, molecular shielding, and a slow and steady release mechanism.
3. Aquasomes' aquatic-matching properties provide a medium for maintaining bio-active conformational integrity and biochemical stability.
4. Aquasomes resist clearance by the reticuloendothelial system and because of their scale and structural integrity, they are resistant

to deterioration by other environmental causes.

2. Method of preparation of aquasomes: [11] The general process entails the creation of an inorganic core, which is then coated with Lactose to create a polyhydroxylated core, which is then filled with model medication. Three stages are included in the preparation of Aquasomes using the self-assembly theory. i.e.

1) Preparation of core
2) Coating of core
3) Immobilization of drug molecule.

3. Characterization of Aquasomes

The structural also morphological things, particle size scattering, and drug loading ability of aquasomes are the most important characteristics.

3.1. Characterization of ceramic core

3.1.1. Size distribution

For morphological description and scale sharing study, scanning electron microscopy (SEM) and transmission electron microscopy (TEM) are widely used. These methods are used to examine heart, coated core, and drug-loaded Aquasomes. Photon correlation spectroscopy can also be used to calculate the mean particle size and zeta potential of the particles. [12, 13]

3.1.2. Structural analysis

For structural analysis, FT-IR spectroscopy may be used. The core as well as coated core can be analysed using the potassium bromide sample disc method by recording their IR spectra in the wave number range 4000–400 cm–1; the characteristic peaks detected are then compared with reference peaks. FT-IR examination of the sample may also confirm the presence of sugar and drug burdened above the ceramic heart. [14, 15]

3.1.3. Crystallinity

X-ray diffraction may be used to determine if the ready ceramic core is crystalline or amorphous. The sample's X-ray diffraction form is compared to a regular diffractogram, and observations are made based on the results. [15, 16]

3.2. Characterization of coated core

3.2.1. Carbohydrate coating :

The concanavalin A–induced aggregation method (which calculates the amount of sugar coated over the core) or the anthrone method (which determines the quantity of sugar covered above the core) can also be used to figure out how much sugar is smeared on the ceramic heart (determines the quantity of boundless sugar or remaining sugar left later coating). Zeta potential calculations can even be put to use validate sugar adsorption over the breast. [14, 15, 16].

3.2.2. Glass transition temperature

The result of carbohydrate on the drug burdened into Aquasomes can be studied using DSC. Glass transition temperatures of carbohydrates and proteins have been studied extensively using DSC techniques. Using a DSC analyzer, the changeover from glass to rubber can be calculated as a change in temperature when glass is melted. [16] Characterization of drug-loaded Aquasomes Drug payload by incubating the simple aquasome preparation (i.e., lacking medication) in a well-known attention of the drug solution for 24 hours at 4°C, the drug filling can be determined. In a refrigerated centrifuge, the supernatant is detached by high-speed centrifugation intended for 1 hour through short temperature. Any appropriate method of analysis can be used to estimate the quantity of drug left in the supernatant liquid later loading. [13]

3.3. In vitro drug release studies

The in vitro release kinetics of the loaded drug was calculated by hatching a known amount of drug-burdened Aquasomes in a buffer of appropriate pH at 37°C using nonstop stirring to research the discharge pattern of drug from the Aquasomes. Periodically, samples are taken and centrifuged at high speeds for a set amount of time. After each removal, equal volumes of medium must be substituted. Any appropriate method is then used to decide the amount of drug free from the supernatants. [16]

3.4. In-process stability studies

During the preparation of the Aquasomes, SDS-PAGE (sodium dodecyl sulphate polyacrylamide gel electrophoresis) can be used to assess the protein's stability and integrity. [14, 15, 16]

4. Application

1. Aquasomes as red blood cell replacements, with haemoglobin immobilised on the oligomer surface due to the conformational sensitivity of haemoglobin's oxygen release. This reduces toxicity, achieving an 80 percent haemoglobin concentration and delivering blood in a nonlinear fashion similar to normal blood cells. [17].
2. Aquasomes, a five-layered composition consisting of a ceramic centre, polyoxyoligomeric film, therapeutic gene section, additional carbohydrate film, and a targeting layer of conformationally conserved viral membrane protein, have been used for effective targeted intracellular gene therapy. [17].
3. Aquasomes used as vaccines for viral antigen delivery, such as Epstein-Barr and Immune Deficiency Virus, must be activated by conformationally specific target molecules in order to elicit proper antibody. [18].
4. Since drug activity is conformationally specific, aquasomes for pharmaceutical delivery, such as insulin, were created. When compared to i.v. administration, bioactivity was maintained and activity increased by 60%, with no confirmed toxicity. [19].

5. Conclusion:

Aquasomes are one of the greatest basic and innovative drug carriers based on the self-assembly theory. Even when conformationally sensitive drug candidates are delivered via aquasomes, they display better biological activity. This is most likely due to the special carbohydrate coating on the ceramic. These formulations have also been found to elicit a stronger immune response, suggesting that they may be used as an immune adjuvant for proteinaceous antigens. As a result, this method gives pharmaceutical researchers a new ray of hope for bioactive molecule distribution Still, much more research on Aquasomes is needed in terms of pharmacokinetics, toxicology, and animal studies to confirm their efficacy and safety, in addition to determine their clinical utility and commercialization.

6. References

1. Chaudhari M, Pandya D, Thakkar P, Soni A, Modi D. 2013. Aquasomes: a novel drug delivery system. ChemInform., 44(38).
2. Girotra L, Bajaj R. 2012. Emerging Trends And Recent Advances In Aquasomes: A Review. Inventi Rapid: Pharm Tech..
3. Shahabade Gururaj S, Bhosale Ashok V, Mutha Swati S, Bhosale Nilesh R, Khade Prashant H. 2009 An overview on nanocarrier technology-Aquasomes. Journal of Pharmacy Research, 2(7).
4. Wani S, Yerawar A. 2011. Aquasomes: A novel nanocarrier for drug delivery. Chem Inform. 42(46).
5. Arakawa, T. and Timasheff, S. N. 1982. Stabilization of protein structure by sugars." Biochemistry, 21:6536-6544.
6. Crowe, J.H.; Crowe, L.M.; Carpenter, J.F.; Rudolph, A.S.; Wistrom. C.A; Spargo, B.J. and Acnhordoguy. T.J 1947. "Interaction of sugars with membrane". Biochem biophys acta:367-384.
7. Kossovsky, Gelman.A. and Sponsler, E.E. 1994 "Cross linking encapsulated haemoglobin solid phase supports: lipid enveloped haemoglobin adsorbed to surface modified ceramic particles exhibit physiological oxygen lability artif.cells blood sub"biotech, 223: 479-485.
8. Jain. N. K. "Advances in controlled drug delivery system"; 317-328.
9. Shahabade Gururaj S, Bhosale Ashok V, Mutha Swati S, Bhosale Nilesh R, Khade Prashant H. 2009. An overview on nanocarrier technology-Aquasomes. Journal of Pharmacy Research, 2(7).
10. Gholap AD, Borude SS, Mahajan AM, Gholap MAD. 2011Aquasomes: A potential drug delivery carrier. Pharmacol Online. 3: 230-7.
11. Mesariya S, Joshi K, Jain H, Upadhyay U. 2012 Aquasomes—A Self-Assembled Nanotechnology System. Chem Inform.; 43(30).
12. Cherian A.K., Rana A.C., Jain S.K. 2000. Self-assembled carbohydrate-stabilized ceramic nanoparticles for the parenteral delivery of insulin. Drug Dev Ind Pharm. 26:459-63.
13. Oviedo R.I., Lopez S.A.D., Gasga R.J., Barreda C.T.Q. 2007. Elaboration and structural analysis of Aquasomes loaded with indomethecin. Eur J Pharm Sci. 32:223-230.
14. Vyas S.P., Goyal A.K., Rawat A., Mahor S., Gupta P.N., Khatri K. 2006. Nanodecoy system: a novel approach to design hepatitis B vaccine for immunopotentiation. Int J Pharm.; 309:227-233.
15. Khopade A.J., Khopade S., Jain N.K. 2002. Development of haemoglobin Aquasomes from spherical hydroxyapatite cores precipitated in the presence of poly(amidoamine) dendrimer. Drug Dev Ind Pharm. 241:145-54
16. Vyas S.P., Goyal A.K., Khatri K., Mishra N., Mehta A., Vaidya, B., et al. 2008. Aquasomes—a nanoparticulate approach for the delivery of antigen. Drug Dev Ind Pharm. 34:1297-1305.
17. Kossovsky, N.; Gelman.A. and Sponsler, E.E (1994c) "Cross linking encapsulated haemoglobin solid phase supports: lipid enveloped haemoglobin adsorbed to surfacemodified ceramic particles exhibit physiological oxygen lability artif.cells blood sub"biotech 223: 479-485.
18. Kossovsky, N.; Gelman, A; Sponsler, E.; Rajguro, S.; Tones, M; Mena, E.; Ly, K and Festeljian, A (1995a) "Preservation of surface-dependent properties of viral antigens following immobilization on particulate ceramic delivery vehicles." 1. Biomed. Mater. REs. 29, 5:561-573.
19. Cherian, A. and Jain S.K. 2000 "Self assembled carbohydrate stabilized ceramic nanoparticles for the parentral drug delivery of insulin" Drug development and industrial pharmacy, 26, 459-463.