INTERNATIONAL JOURNAL OF PHARMACY AND ANALYTICAL RESEARCH

ISSN: 2320-2831

IJPAR |Vol.10 | Issue 2 | Apr - Jun -2021
Journal Home page: www.ijpar.com

Review Study *Open Access*

Aquasomes: A Novel Carrier for Drug Delivery

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ABSTRACT

This method is known worldwide for nanoparticular carriers is referred to as aquasoms.Aquasomes are the type of nanoparticles and made up of three layered self-assembled structures, consisting of a solid phase nanocrystalline core covered with oligomeric film, biochemically active molecules that are typically absorbed with or without modification.Aquasomes are a nano-biopharmaceutical carrier device consisting of a particle center consisting of a nanocrystalline calcium phosphate or a ceramic diamond surrounded by a polyhydroxy oligomeric film.Aquasomes are spherical in forms containing 60-300 nm particles used for drug and antigen distribution. Their characteristics are that they shield and maintain delicate biological molecules, conformation integrity, and surface visibility, allowing aquasomes a good carrier mechanism for unique sites for bio-active molecules such as peptides, proteins, hormones, antigens, and genes. Three types of core materials are primarily used for the processing of Aquasomes: tin oxide, nanocrystalline carbon ceramic (diamonds) and brushite (calcium phosphate dihydrate). Brushite is unstable, and it is converted to hydroxyapatite when stored for a long time, and Calcium Phosphate is the core that is naturally present in the body. As a result, hydroxyapatite appears to be the better core for aquasome preparation. It's primarily used in the preparation of implants for drug delivery. Drug delivery via aquasomes is facilitated by precise targeting, molecular sheeling, and a slow, sustained release process.

Keywords: Aquasomes, self-Assembling carrier system, Nanoparticles

INTRODUCTION

The “Somes” the cell like formulation of novel drug delivery system. In few decades, many technological strategies are proposed for obtaining nanoparticles of different nature, this has made a revolutionary change in drug administration system. Drug delivery vehicle aquasome is a colloidal range biodegradable nanoparticle, so that they will be more concentrated in liver and muscles. Because the drug is absorbed on the surface of the system without having any surface modification, they will not have any difficulty in recognition of receptor on the active sites so that the pharmacological activity can be achieved immediately. “Bodies of water” another name of aquasome, as they are having properties of water which protect and preserve fragile biological molecules, and carrying these properties conformational integrity as well as high degree of surface exposure is exploited in targeting of bio-active molecules like peptide and protein hormones, antigens and genes to specific site. These carbohydrates stabilize nanoparticles of ceramic are known as “aquasomes” which was first developed by Nir Kosovska whose particle size (lower than 1000

nm). These pharmacologically active molecules are unified by copolymerization, diffusion or adsorption to carbohydrates surface of pre formed nanoparticles [1,2]. Mainly three types of core materials are used for producing aquasomes: tin oxide, nanocrystalline carbon ceramics(diamonds) and brushite (calcium phosphate dihydrate). Aquasomes discovery comprises a principle from microbiology, food chemistry, biophysics and many discoveries including solid phase synthesis, supramolecular chemistry, molecular shape change and self-assembly [3,4]. Self-assembly implies that the constituent's parts of some final product assume spontaneously prescribed structural orientations in two- or three-dimensional space. The self-assembly of macromolecule in the aqueous environment, either for the purpose of creating smart nanostructure materials or in the course of naturally occurring biochemically, these three-layered structures are self-assembled by non-covalent bonds. Principle of "self-assembly of macromolecule" is governed by three physiochemical process [5]. For Example - (Fig 1)

1. Interaction between charged group
2. Hydrogen bonding and dehydration effect
3. Structural stability

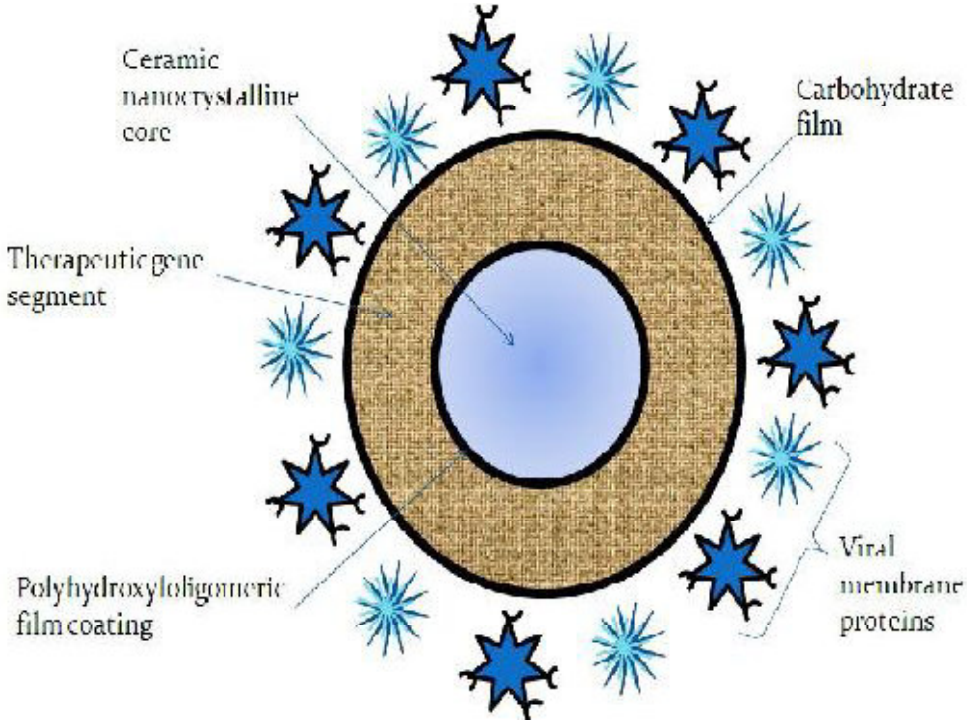
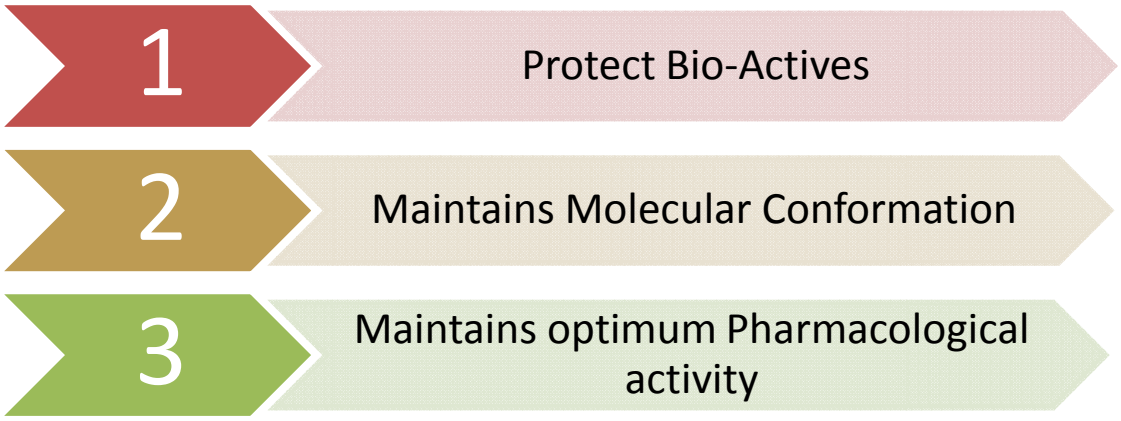


Fig 1 - Structure of aquasome

OBJECTIVE[7]



PROPERTIES[8-10]

1. Aquasomes have a large size and an active surface, so significant quantities of agents can be loaded efficiently by ionic, non-covalent bonds, van der Waals and entropic forces. The physical properties of colloids are seen as solid particles scattered in an aqueous environment.
2. The mechanism of action of the aquasomes is regulated by their surface chemistry. Aquasomes provide content by incorporating precise targeting, molecular shielding, and the mechanism of gradual and sustained release.
3. The water-like properties of Aquasomes provide a medium to maintain the conformational integrity and bio-chemical stability of bio-actives.
4. Aquasomes avoid clearance by the reticuloendothelial system or degradation by other environmental challenges because of their size and structural stability.
5. As a carrier, aquasomes protect the drug/antigen/protein from harsh pH conditions and enzymatic degradation, resulting in lower doses.
6. The mechanism of action of aquasomes shall be governed by their surface chemistry.

METHOD OF PREPARATION OF AQUASOMES[11-16]

1. core preparation
2. Coating of core material
3. Immobilization of drug candidate

1. Core preparation: The first step in the preparation of the aquasome is the production of the ceramic core. The ceramic core preparation process depends on the selection of core materials. Colloidal precipitation and sonification, inverted magnetron sputtering, plasma condensation and other processes can produce these ceramic cores. Ceramic materials have been widely used for the core, since ceramics are structurally the most common materials known. The high degree of ceramic order, crystalline, means that any surface alteration can have only a minimal impact on the existence of the atoms below the surface layer, thereby maintaining the ceramic's bulk properties. The high degree of order also ensures that high levels of surface energy are exhibited on the surfaces that favor the binding of polyhydroxy oligomeric surface film. In order to extract sodium chloride produced during the action, the precipitated cores are centrifuged and then washed with appropriate distilled water. In distilled water, the precipitates are resuspended and passed through a fine membrane filter to collect particles of the desired size.

2. Carbohydrate coatings: the second stage involves carbohydrate coating on the surface of the ceramic cores. There are a range of processes that allow the coating of carbohydrates (polyhydroxy oligomers) to adsorb epitaxially on the surface of nano-crystalline ceramic cores. The processes usually include the addition of polyhydroxy oligomers to the dispersion of meticulously washed ceramics in ultra-pure water, sonication and lyophilization to facilitate the mostly irreversible adsorption of carbohydrates on ceramic surfaces. Excess and quickly desorbing carbohydrate is extracted by ultrafiltration of the stir cells. The most widely used coating materials are cellobiose, citrate, pyridoxal-5-phosphate, sucrose and trehalose.

3. Drug immobilization: surface modified nano-crystalline cores provide a solid step for subsequent non-denaturing self-assembly for a wide variety of biochemically active molecules. The drug can be charged by partial electron microscopy of adsorption. Morphology and size distribution were obtained through scanning electron microscopy images. (Fig 2).

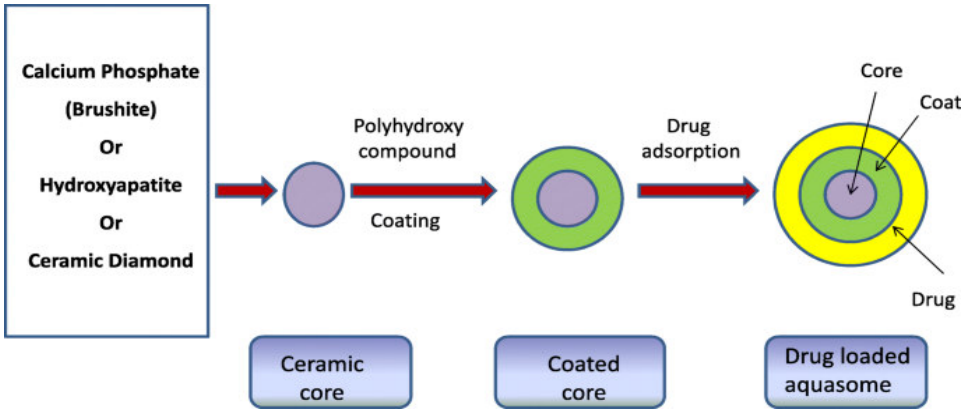


Fig. 2- Drug Immobilization

MATERIALS USED AND ITS IMPORTANTS[17-23]

Polymersand ceramic both cores can be used initially for the preparation of nanoparticles. The polymers used are albumin, gelatin or acrylate. Diamond flakes, brushite (calcium phosphate) and tin oxide core are the ceramics used. Ceramic materials were commonly used for heart, since ceramics are structurally the most commonly known materials, being crystalline high order guarantees a high degree of order.

(a) Any alteration of the surface will have a minimal effect on the nature of the atoms below the surface layer and thus the bulk properties of the ceramic will be preserved.

(b) The surface will exhibit a high degree of surface energy which will favor the binding of the polyhydroxy oligomer surface film.

Within fractions of seconds, the freshly prepared particles have good adsorbing molecules. The second stage was preceded by the epitaxial coating of carbohydrates over the nanocrystalline ceramic heart. Cellobiose, pyridoxal-5-phosphate, sucrose and trehalose are the widely used coating products, the presence of carbohydrate film prevents soft drug from changing form and being weakened when surface attached. Adsorbed third stage bioactive molecules that have the property of interacting with film through non-covalent and ionic interactions.

CHARECTERIZATION OF AQUASOMES[24-27]

- X-ray powder diffractometry
- Transmission electron microscopy
- Scanning electron microscopy
- Drug Loading Efficiency
- Particle size distribution
- Zeta Potential
- In-vitro drug release
- Structural and morphological properties

APPLICATIONS OF AQUASOMES[28-32]

1. Aquasomes are hemoglobin immobilized on the oligomer surface as red blood cell substitutes because hemoglobin release of oxygen is confirmatively responsive. This toxicity decreases the concentration of hemoglobin by 80%, which is recorded to deliver blood in a non-linear way, like normal blood cells.

2. Aquasomes are used as vaccines for viral antigen delivery, i.e. In order to elicit the right antibody, Epstein-Barr and Immune Deficiency Virus, the purpose of vaccine therapy must be caused by unique conformational target molecules.

3. Aquasomes have been used for active targeted intracellular gene therapy, a five-layer composition consisting of ceramic center, polyoxyoligomeric film, therapeutic gene section, additional carbohydrate film and a conformationally conserved viral membrane protein targeting layer.

4. Aquasomes for the delivery of pharmaceuticals, i.e., insulin, produced as the action of drugs is conformationally specific. Preserved bioactivity and activity increased to 60% relative to i.v. Unreported administration and toxicity.

5. Aquasomes are also used to distribute enzymes such as DNA and pigments/dyes since the activity of enzymes fluctuates with molecular conformation and pigments' cosmetic properties are sensitive to molecular conformation.

CONCLUSION

In this paper observed aquasomes are one of the simplest yet novel drug carriers based on the fundamental principle of self-assembly. Even when conformationally sensitive drug candidates are delivered via aquasomes, they show better biological activity. Aquasomes, which are self-assembling surface-modified nanocrystalline ceramic cores, appear to be promising carriers capable of preserving the structural integrity of protein pharmaceuticals and serving as a carrier for a wide range of molecules such as viral antigens, hemoglobin, and insulin, resulting in improved therapeutic effects.However, a considerable further study of aquasomes with respect to pharmacokinetics, toxicology and animal studies is needed to confirm their efficacy and safety, in order to establish their clinical usefulness and commercially launch them. The aquasome-based strategy would therefore be significant in the noval delivery of other bioactive molecules.

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