V Semester

Paper: Nano biotechnology

Topic: Dendrimers

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DENDRIMERS

Dendrimers are highly branched, three-dimensional polymeric molecules with a well-defined structure.

Dendrimers typically range in size from 1 to 10nm.

They exhibit a low degree of size variation, meaning they are relatively uniform in size.

Dendrimers are nanosized composite materials known as dendrimer nanocomposites. depending on the chosen number of generations (G0–G10).

Nanocomposites are divided into: polymer nanocomposites,

ceramic nanocomposites

and metal nanocomposites.

Polymer nanocomposites are now widely used as new materials in industry.

They are also known as “cascade molecules. The dendrimer architecture has three main mechanisms for drug loading, namely, molecular entrapment within

1. a central core (dendritic nano encapsules).

2. generations of tree-like branching points attached to the central core (making hydrogen bonds between dendrons and drug molecules)

3. and terminal functional groups (surface groups by electrostatic interactions).

According to the nature of the end groups, the dendrimers have very shapes, stability, solubility, rigidity or flexibility, and viscosity.

Dendrimers have a central core with branching arms that create internal cavities, which can be used to encapsulate molecules.

Dendrimers as biological agents:

- Nontoxic
- Non immunogenic
- Bio-permeability
- Bio-degradability
- Able to stay in circulation in the biological system
- Able to target specific biological systems

Key properties that make dendrimers useful

- Controlled Size and Shape
- High Surface Area
- Tunable Properties

(polyamidoamine) PAMAM- is perhaps the most well- known dendrimer. The core of PAMAM is a diamine (commonly ethylenediamine)

To this end, polyamidoamine (PAMAM) dendrimers have emerged as promising, well-defined nanocarriers for targeted anticancer drug delivery;

Dendrimers possess a unique molecular architecture consisting of a central core, dendrons, and peripheral functional groups, located on the outer surface of the macromolecule, that control DNA formation, drug encapsulation efficacy, and cellular targeting. Cellular ligands such as folic acid, hyaluronic acid, transferrin, peptides, and antibodies have been extensively applied for the development of tumor-selective drug delivery systems

The binding strength of the encapsulated 6-mercaptopurine (6-MP) within the nanocavities of the amine-terminated dendrimers was quantitatively expressed using epitope maps. Furthermore, the binding constants of internal nanocavities of dendrimers and catecholamines were measured by UV–Vis, fluorescence, and 1D and 2D NMR spectroscopy.

Applications:

1. Drug delivery: Targeted delivery

   Controlled release

   Enhanced solubility and bioavailability

2. Gene delivery: Efficient gene transfer

   Protection of genetic material

3. Diagnostics: MRI contrast agents

   Biosensor

4. Nanomaterials: Coatings and Films

   Catalysis:

   Materials Science

5. Other Applications: Cosmetics

   Agrochemicals

   Food Industr: