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A REVIEW PAPER ON NANOPARTICLES FOR DRUG DELIVERY

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ABSTRACT:

The study of nanostructured drug delivery systems enables the development of novel platforms for the efficient transport and controlled release of drug molecules in the harsh microenvironment of diseased tissues of living systems, providing a broad range of functional nano-platforms for smart biotechnology and nano-medicine applications. Recent developments in smart nano carriers consisting of organic materials (including polymer micelles and vesicles, liposomes, dendrimers and hydrogels) and inorganic materials (including quantum dots, gold and mesoporous silica nanoparticles) are highlighted in this article. Despite the remarkable advances in recent synthetic methodologies, the behaviour of most nano carriers is linked to a range of undesirable side effects that decrease their efficient use in applications of biotechnology and nanomedicine. This highlights some important problems arising from the complex environment and multiform interactions within the specific biological media in the design and engineering of nano carrier systems for biotechnology applications.

KEYWORDS: *Applications, Biotechnology, Drug, Delivery, Smart, Medicines, Guidelines.*

INTRODUCTION

In recent decades, a wide variety of biotechnology applications have been developed to develop novel approaches for the construction of nano formulations (nano carriers) for the efficient transport of drug molecules. Smart nanostructured materials can deliver drugs with reduced dose frequency to the target sites and in a controlled (spatial/temporal) manner to minimise the side effects associated with conventional therapies [1].

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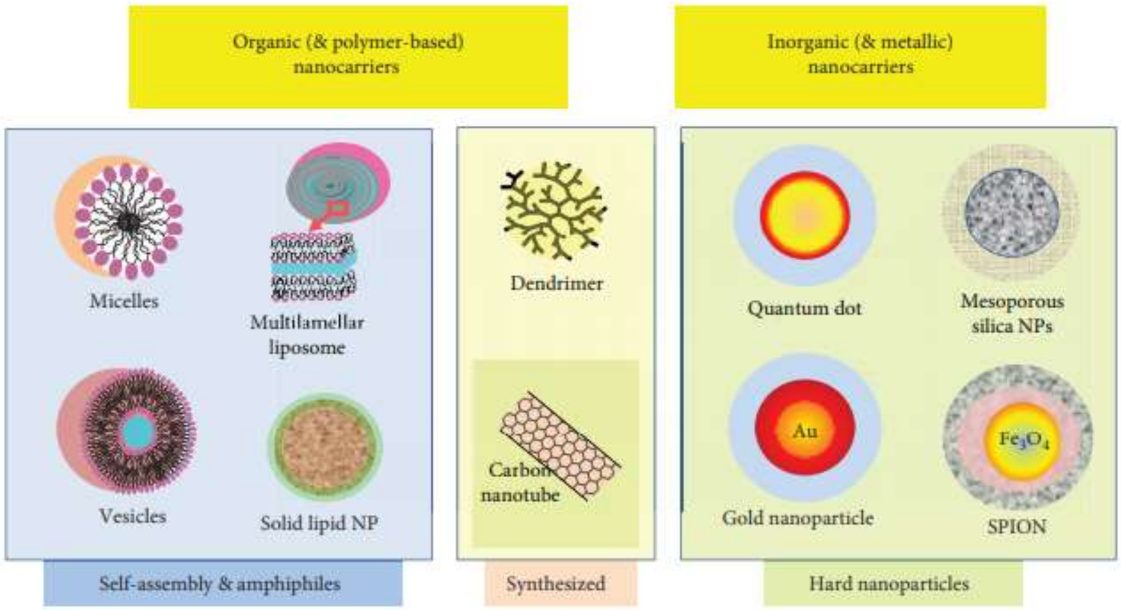

Figure 1: Illustrates the smart applications in drug delivery

In particular, the key critical problems faced by traditional pharmaceutical therapies, such as non-specific delivery, rapid clearance, uncontrollable drug release, and poor bioavailability, can be solved. Responsive reductions in toxicity and/or adverse reactions are the ultimate result [2]. Despite the remarkable advances in recent methodologies, however, the behaviour of most nano carriers is linked to a range of unexpected side effects that decrease their successful use in nanomedicine. This highlights some important problems arising from the complex environment and multiform interactions within the specific biological media in the design and engineering of nano carrier systems for biotechnology applications [3].

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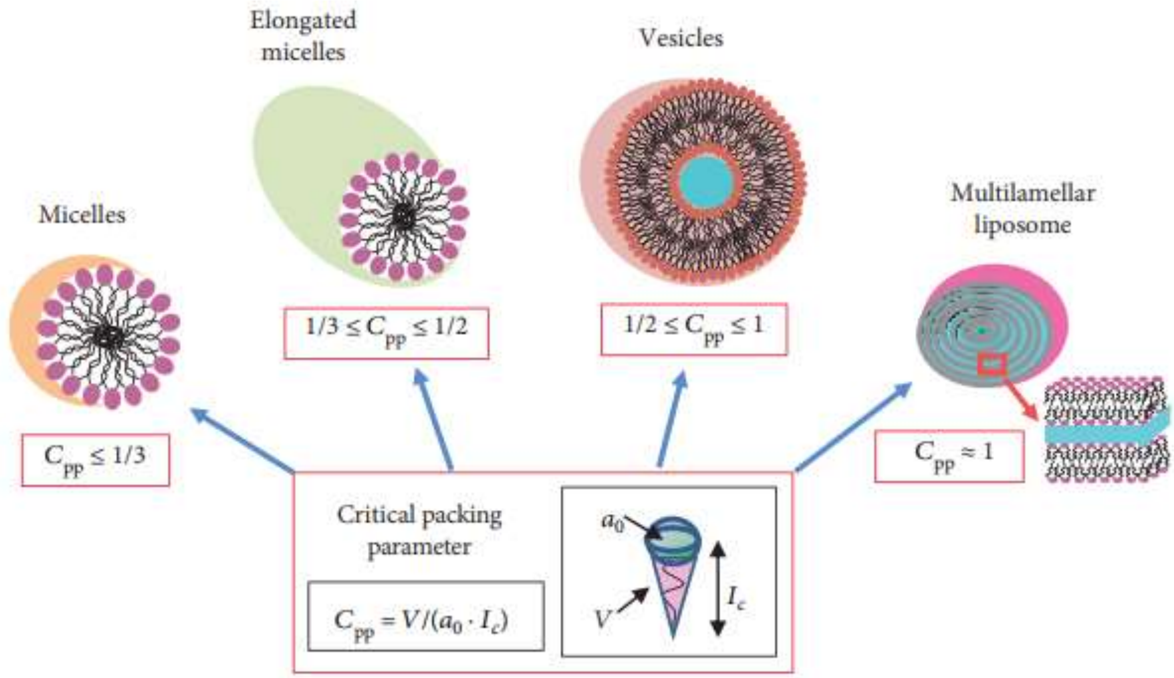

Figure 2: Illustrates the amphiphilic nanocarrier morphology [4]

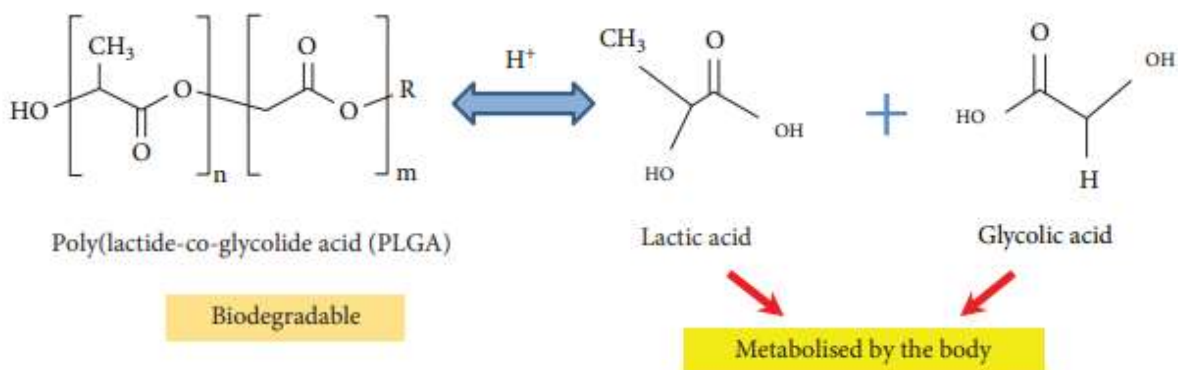

Figure 3: Illustrates the biodegradability of the PLGA polymer [5]

DISCUSSION

The recent development of nanostructured nano carrier systems for drug delivery applications with a focus on the key properties and applications of major organic nano carriers (such as polymer-

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based micelles, liposomes and dendrimers) and inorganic nanoparticles is highlighted in this article (such as carbon nanotubes, gold nanoparticles, and quantum dots) [6]. The key factors (and parameters) which have a strong effect on the design of nanostructure systems for the delivery of active drugs and chemotherapeutics are analyzed [7]. In addition, we have shown the current status of nano platforms for therapeutic applications (challenges and limitations) and emerging approaches [8]. A number of critical problems related to sensitive toxicity, low specificity, and drug resistance induction are present in traditional drug delivery systems of chemotherapeutic agents, which sensitively reduce the therapeutic efficiency of many drug systems [9]. Nano carrier-based platforms are dedicated structures for the transport of active chemotherapeutic drugs consisting of submicron-sized colloidal nanoparticles. Figure 1 illustrates the smart applications in drug delivery. Figure 2 illustrates the amphiphilic nanocarrier morphology. Figure 3 illustrates the biodegradability of the PLGA polymer. Figure 4 depicts the (a) Micellar self-assembly (b) and hydrophilic/hydrophobic drug encapsulation characteristics (c).

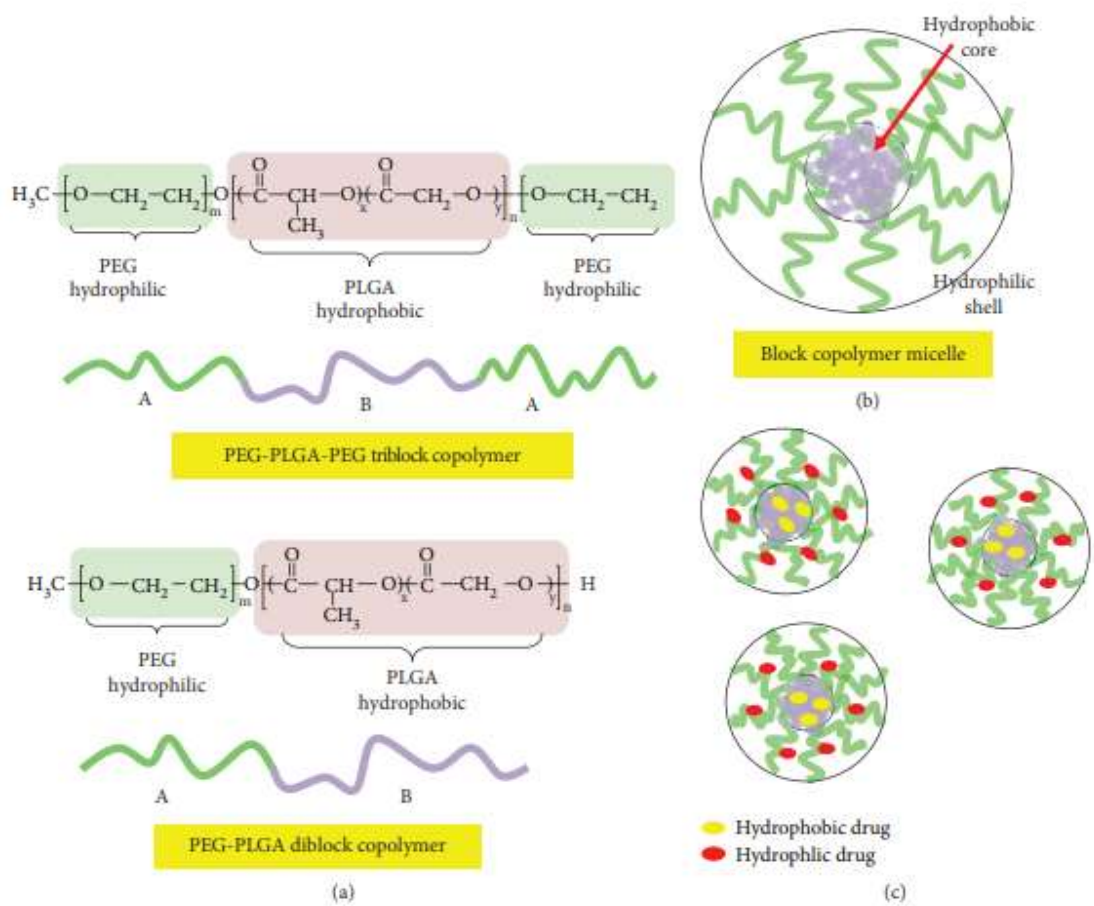

Figure 4: Depicts the (a) Micellar self-assembly (b) and hydrophilic/hydrophobic drug encapsulation characteristics (c) [8]

CONCLUSION

Recent developments in the development of novel platforms for efficient transport and controlled release of drug molecules by smart nano carriers are highlighted. The main objective of efficient nanostructured delivery systems is to minimize the dosage of pharmaceutical products necessary to achieve a particular therapeutic result, thus reducing costs and reducing the side effects of their use. A variety of complementary and synergistic properties that can be profitably exploited are present in the two major categories of organic and inorganic nanostructured materials commonly used in drug delivery processes. On the one side, there are better properties for organic soft nano carriers (such as amphiphilic polymers and liposomes) to match the physicochemical conditions found in biological (and pathological) tissues, offering the best examples of biocompatible nanostructures. On the other hand, strong nanoparticles made up of inorganic materials (such as quantum dots and nanoparticles of gold and mesoporous silica) suggest complementary roles for the diagnosis and identification of pathological conditions in diseased tissues. The choice of nano carrier properties (such as size, shape, material substrate, and surface chemistry) plays a crucial role in the design of efficient nano carriers for specific functions, since the micro environmental conditions within the diseased tissues have a major impact on the delivery efficiency of nano carrier systems.

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