Research Article

Preparation of Egg Albumin Nanoparticles (EANPs) by Using Toluene-Butanol Desolvation Method

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ABSTRACT

Egg albumin nanoparticles (EANPs) are considered safe, economic and biocompatible drug carrier systems to carry out effective targeted delivery. EANPs have low-cost and safe nanomaterials to carry out more improved drug loading capacity for loaded bioactive molecules with high site specificity and low cytotoxicity and desired delivery rate. Size controlling of EANPs was carried out by using improved and modified methods to make them more potent nonviral vehicles to carry out significant controlled and sustained targeted drug delivery to be bind with other desired components by using Nanotechnology Albumin Binding Technology (nab technology). In proposed work, EANPs were prepared by using toluene-butanol desolvation method to achieve more controllable particle size at nanoscale. DLS (Dynamic Light Scatting) was used to characterize the size distribution of the prepared EANPs. The prepared EANPs were found to attained size range up to 2 nm with exhibited diameter up to 280.1 nm and width of 97.49 nm which are observed to attained good narrow size distribution at nanoscale level. Hence, this proposed toluene-butanol desolvation method can be a safe and low-cost nanopractice to prepare nanosized EANPs which may prove more safe and potent drug and gene delivery nonviral nano-therapeutic tool.

Keywords: Egg albumin nanoparticles, EANPs, Desolvation, Dynamic Light Scattering (DLS).

INTRODUCTION

Protein nanoparticles have been recognized more potent nanocarriers to deliver low molecular-weight drugs, anticancer drug, DNA, vaccines, oligonucleotides and peptides. Recently, egg Albumin (EANPs) nanoparticle were prepared having suitable size/size distribution and good surface properties for drug delivery application by employing Taguchi method that was based on simple coacervation method along with optimization of the nanoparticles.[1] In last decade, albumin nanoparticles have been studied for delivery of various active pharmaceuticals compounds and drugs with their enhanced accumulation at the site of inflammation. And, albumin was found to be effective versatile carrier to prepare nanoparticles and nanospheres due to its easy availability in pure form, biodegradability non-toxic and non-immunogenic characteristic.[2] Previously, various aceclofenac-loaded chitosan-egg albumin nanoparticles had been also prepared through heat coagulation method and characterized by FE-SEM, FTIR, DSC and P-XRD analyses. Highest drug entrapment was noticed with 352.90 nm average particle diameter and -22.10 mV zeta potential.[3]

Moreover, due to defined nanostructure of protein and albumin based nanoparticles are alos offered various possibilities for safe and low-cost surface approach including covalent loading/ binding of drugs and tagging photoluminescent ligands to be considered as effective site specific nonviral tagted loading vehicle used in cancer, tumor, neurodegenerative and spinomuscular diseases gene/drug therapy.[4] Carvedilol containing egg albumin nanoparticles were also prepared by coaservation method using Gluteraldehyde and ethanol as the cross linking agent. The results were showed that this method was reproducible, very easy and led to the efficient entrapment of drug as well as formation of spherical particles ranging from 500 nm to 1000 nm. The maximum percentage drug entrapment and percentage yield were also depicted with effective sustained release behaviour of EANPs.[5] Nanotechnology-driven biocatalysts were also analyzed and observed to be a promising key factor in binding of desired chemical and biological components on to various activated potential biocompatible nanomaterials for efficient particle mobility.[6] Other nanotechniques had been used to prepare EANPs such as desolvation,

emulsification, coacervation, thermal gelation, nab-technology, nano-spray drying and self-assembly that have been studied to investigate their fabrication of albumin nanoparticles.[5,6] Albumin nanoparticles were also know as potential nonviral nanovehicles for passive drug targeting with their good ease of using respective optimized manufacturing technique.[7,8] EANPs were also synthesized by desolvation to control their size, diameter and width to attain narrow size distribution with the size of 100 to 300 nm.[9] Hybrid EANPs had been also successfully prepared and called, chitosan based nanoparticles that were used for delivery of proteins and peptides as low cost and nontoxic nonviral gene delivery vehicle.[10] Synthesis and characterization of various fabricated BSANPs were also reported by using modified emulsification[11-17] and desolvation[7] nanotechniques.[11-17]

Hence, this proposed work was designed to carry out the synthesis of fine sized EANPs by using modified toluene-butanol desolvation method using toluene and butanol, They were further characterized by DLS. And, this modified desolvation method was found to be easy and low-cost alternative to prepare EANPs that can be used as effective and non-toxic drug/ gene delivery nonviral drug or gene bound BSANPs. As well as, it can be employed in potential therapeutic applications used in regenerative medicine, nanomedicine and molecular medicine.

MATERIALS AND METHODS
Preparation of EANPs by Toluene-Butanol Desolvation method
EANPs were prepared by toluene-butanol desolvation method given by Rani, K. &

Chauhan, C., 2015[7] and Rani, K., 2015[12] and with slight modifications. Dropwise addition of 2-3ml of n-butanol was done into prepared 8-9 ml of egg solution kept under the magnetic stirrer till the formation of opalescent suspension. After this, 4-5ml of toluene was added and activated reaction solution was kept overnight with continuous stirring. The reaction solution was centrifuged at 5000 rpm at 4^0C for 20mins. The, it was dispersed it in chilled acetone and subjected to sonication to keep it in bath sonicator for 30-35 minutes.[7,12]

Characterization of Prepared EANPs by Dynamic Light Scattering (DLS) Method
The prepared EANPs were characterized by using Dynamic Light Scattering (DLS) Method for the interpretation of their nanosize distribution with exhibited particle size and diameter.[12,5,7,12-17]

RESULT AND DISCUSSION
Characterization of Prepared EANPs by Dynamic Light Scattering (DLS) Method
Characterization of Prepared EANPs was done with Dynamic Light Scattering (DLS) Method to interpret their size distribution (Fig 1). Exhibited sharp first DLS peak was observed that depicted the exhibited fine sized of prepared EANPs in-between 0.7 nm to 2 nm with exhibited diameter up to 280.1 nm and width of 97.49 nm followed by another two peaks relative to particle size distribution shown by another mixed competitive particles (Fig 1). This DLS result of EANPs were found to be very similar with previous reported DLS data.[1,2,5,7,12-19]
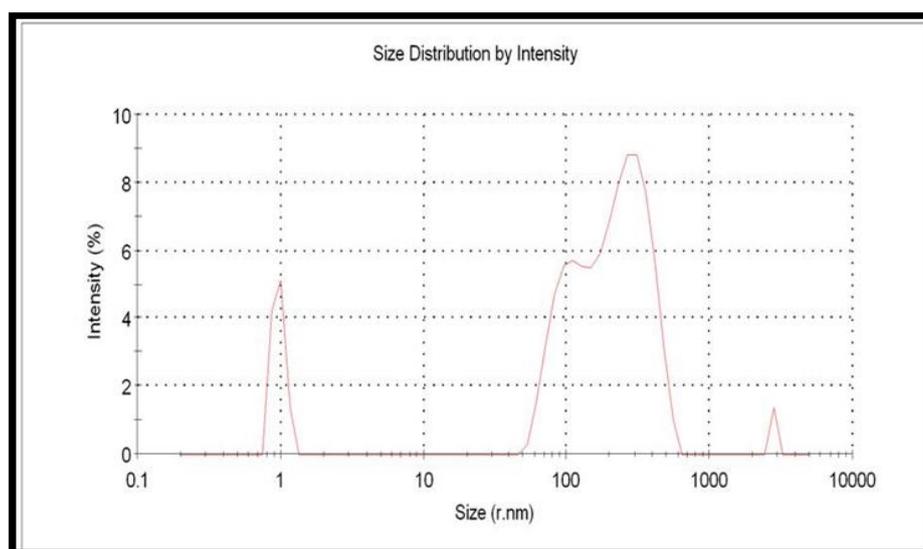

Fig 1: DLS of EANPs by using Toluene-Butanol Desolvation method

CONCLUSION

From this study, it was concluded that designed Toluene-Butanol Desolvation method was easy and low-cost method to synthesize ultra-fine nanosized EANPs of 2 nm with exhibited diameter up to 280.1 nm and width of 97.49. Hence, this designed modified desolvation nanopractice can be proved easy, low-cost and green alternative over other costly and tedious chemical methods. So, it can be further improved by varying differential centrifugation cycles, agitation and sonication cycles to achieve desired poly disparity index of proposed EANPs to get more ulta-fine nanosized particles. Further, it can consider at industrial scale and further employed for carry out targeted drug and gene delivery.

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