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A multivariate analysis investigating different factors important for the interaction between liposomes and pectin

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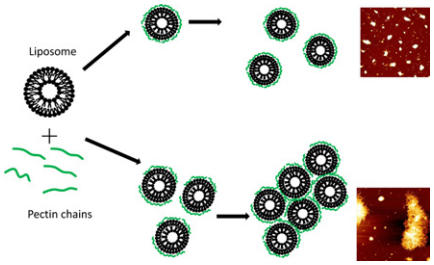
HIGHLIGHTS

- Multivariate analysis successfully identified critical factors for liposome coating.
- High charge density on the liposome surface promoted adsorption of pectin.
- High pectin to lipid ratio produced stable single coated liposomes.

GRAPHICAL ABSTRACT



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ABSTRACT

Liposomes coated with a biopolymer such as pectin have a great potential in drug delivery. The drug formulation may be less toxic and in addition the mucoadhesive properties may be increased. The aim of this study was to investigate how different important factors affect the ability to produce single stable pectin coated liposomes. Experimental design and multivariate analysis were used in order to investigate many factors in a systematic manner by the use of a minimum of experiments. In a reduced factorial design, 2^{4-1} design, the pectin concentration, lipid concentration, amount of charged lipid and the speed of addition under preparation were investigated. A central composite design investigated the three most important factors from the 2^{4-1} design on three levels. The response variables in the studies, analysed by multivariate analysis, were the zeta potential and the change in particle size. These two parameters are important factors for verifying a successful coating of the liposomes. Summarizing the results from both designs revealed the most important factors for a successful coating, indicated by a high negative zeta potential, to be a high amount of charge in the lipid membrane and a low lipid to pectin ratio. The size of the coated liposomes was increased when the pectin concentration was high, indicating more complete covering of the liposomes. The size increased even more with a high lipid to pectin ratio probably due to bridging flocculation. To produce stable single pectin coated liposomes it is important to have enough pectin to cover the liposomes completely. In addition the charge density of the liposomes should be high since this promotes adsorption of pectin

1. Introduction

Liposomes are small nano-sized lipid based vesicles used for delivery of both hydrophilic as well as hydrophobic drugs [1]. Liposomes are considered unstable and some of them are toxic. In order to protect the liposomes from degradation, aggregation and fusion, the liposomes can be coated with a polymer [2,3]. In addition, by coating the liposomes with a biopolymer such as pectin, alginate or chitosan the mucoadhesiveness of the liposomes can be increased and a polymer coat could potentially prolong the drug release [4,5].

Many factors will determine if there will be a successful covering when liposomes are coated with different polymers. In order

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