Effect of various preparation conditions and stabilizers on physical stability of zein nanoparticles manufactured with the aid of ultrasonication

By:
Reem Sandid
Supervisor:
Dr. Ahmad Aljaberi

Abstract

In this study, the physical stability of zein nanoparticles prepared via ultrasonication method was investigated by evaluating the effect of various preparation conditions and stabilizers. Several factors were studied as pH of the aqueous phase, zein concentration, stabilizer concentration, dilution ratio, and storage condition. The measured parameters were the particle size, polydispersity index, and zeta potential of zein nanoparticles. Two stabilizers were examined, pluronic F68 and cremophor EL (hereinafter referred to simply as cremophor) as nonionic stabilizers at the following concentrations 0.25%, 0.5%, 0.75% and 1% w/w. Along with 1g, 2.5g and 4g/100ml of zein protein stock solution. They were prepared under different pH values of 3, 5, 7 and 9 at 1:4, 1:9, 1:19 and 1:29 dilution ratios. The physical stability of zein nanoparticles were monitored for six months at two conditions, namely at room temperature (15-25 □C) and under refrigeration (2-5 □C).
Overall, acceptable nanoparticles could be only prepared at pH 9, where all other pH values resulted in aggregates. Zein nanoparticles formed using both stabilizers resulted in particle size values less than 300 nm and zeta potential range from -15 to -30 mV. For pluronic F68, zein nanoparticles remained stable for three months at both conditions. However, aggregates had formed after six months at high dilution ratios. This aggregation was mostly reflected at room temperature samples. As for the non-aggregated samples, most of them showed PDI values higher than 0.5 indicating a broad particle size distribution, which is unacceptable. Thus, pluronic F68- zein nanoparticles are considered physically unstable. Unlike pluronic F68, cremophor- stabilized zein nanoparticles at pH 9 remain stable at room temperature as well as under refrigeration through six-month storage without being aggregated. However, most of the cases presented a polydispersity of two peaks: one is small ranging between 5-40 nm and the other is large between 85-260 nm. This phenomenon was only observed with cremophor due to the micelles formation. In conclusion, the study demonstrated the optimal conditions to prepare physically stable zein nanoparticles with cremophor as a stabilizer. Consequently, the use of the resulting cremophor-stablised zein nanoparticles could be used for further studies with the purposes of developing a successful nano-drug delivery system, especially in the context of poorly soluble drugs.