Screening the influencing factors of gentamicin-*N. sativa* oil emulsions (GNE) characteristic using Plackett-Burmann design (PBD)

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ABSTRACT

Objectives/Research Problem: Treatment of osteomyelitis using gentamicin has several challenges such as low permeability, ototoxicity, and reduced effectiveness against biofilm bacteria. Therefore, in this study, gentamicin is fused with *Nigella. sativa* oil (NSO) as a strategy to improve gentamicin's potency. Plackett-Burman design (PBD) was used to screen and understand the effect of several parameters affecting the physico-chemical properties of GNE.

Materials and Method: Gentamicin sulphate (GS) powder was purchased from local pharmacy in bulk. Cold pressed NSO was purchased from Hemani (Pakistan). The type of emulsifier used were Span® 20, 40, 60, and 80, Tween® 20, 40, 80 and 85, Castrol oil, TritonX 100, polyvinyl alcohol (PVA), and polyethylene glycol 400 (PEG400). The PBD with 20 experiments was constructed using Design Expert software. The factors selected to be used in the design were NSO concentration (X_1), emulsifier concentration (X_2-X_{12}), type of machines (homogenizer and sonicator) (X_{13}), homogenization time (X_{14}) and rate (X_{15}). Two experimental responses were droplet size (Y_1), and polydispersity index (PDI) (Y_2).

Results and Discussion: From the experiment, the droplet size ranged from 205.44 nm to 1011 nm and the PDI ranged from 0.24 to 0.7. The significant factors ($p<0.05$) affecting the droplet size were the concentration of NSO, Tween 40, and TritonX 100. The statistical analysis showed that Tween 20, 40, 80, Span 80, and the machine were significantly influenced the PDI. Adding NSO would significantly increase the droplet size, while the presence of Tween 40 and TritonX 100 were able to decrease the droplet size. Sonicator was able to lower the PDI together with Tween 20, 40, and 80. However, adding more Span 80 into the system would increase the PDI.

Conclusion: The amount of NSO plays important role for the GNE formulation, while adding several emulsifiers may stabilize the emulsion. Sonicator is the best choice to achieve stable emulsion by lowering the PDI.

KEYWORDS: Gentamicin, *N. sativa* oil, Plackett-Burmann design

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