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Research Article

Synthesis and Optimisation of Cinnamomum Zeylancium Loaded PLGA Nanoparticles

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Abstract – The capacity of nanoscale drug delivery systems to condense a variability of healing agents has been established. By encapsulating these plant extracts, the solubility and stability of drugs is increased. Cinnamon is a possible medicine for several curable diseases, such as diabetes. Nanoencapsulation of Cinnamomum zeylanicum powder was carried out using the solvent evaporation method to improve its bioavailability as a medication. The effect from PVA (polyvinyl alcohol) and Pluronic F-68 on organic solvents and surface-active agents has been investigated. Various parameters such as sonication time, outcome of PLGA content, effect of drug content was studied for optimization of Cinnamon loaded PLGA nanoparticles.

Keywords – Poly Lactic-co-Glycolic Acid (PLGA), Polymeric Nanoparticles, In-vitro studies, Cinnamon, Kinetic Release Study

I. INTRODUCTION

Cinnamon has strong antibacterial activity but limited bioavailability, therefore a biodegradable nano-formulation was created to improve its efficacy, speed up the commencement of therapeutic action, and boost medication absorption. [1] As a result, nanoencapsulation of hydrophobic biologically active compounds was carried out in order to improve the efficacy and efficiency of an antimicrobial chemical found in traditional herbal plants in the drug delivery system. Nanoparticles have a number of advantages due to their small size, including the ability to permeate places (both intracellular and extracellular) that would be inaccessible to other drug delivery techniques. Nanoparticles have the ability to shield any medicine from degradation while also reducing negative effects. [2] Among all the biodegradable polymers utilized in the creation of nanoparticles, PLGA has the most potential as a drug delivery vehicle and is the most widely acknowledged. Because of its extensive clinical history and breakdown features, PLGA is a biodegradable polymer. As a result, they are having the potential for long-term medication delivery [3]. The advancement of PLGA nanoparticles has been reported quite high, still various research studies shows that Cinnamon PLGA nanoparticles depicts varying degrees of inhibition zone [4]. In the present study Cinnamon-loaded PLGA nanoparticles were synthesized and optimized. Nanoparticle formulation minimizes drug toxicity while simultaneously allowing for slow and consistent drug release. The solvent evaporation approach was

used to synthesize Cinnamon loaded PLGA nanoparticles with various formulations in order to improve the antibacterial and encapsulating performance of Cinnamon in uniform and also to achieve the tiny size of PLGA nanoparticles.

2. Materials and Method

Materials: Cinnamon was purchased from local market. The polymer poly (D,L-lactide-co-glycolide) (PLGA)having a copolymer ratio of 50:50 (Mw = 24000 to 38000) was obtained from Sigma-Aldrich). The surfactants Pluronic F-68 and Polyvinyl alcohol (PVA)(Mw 30,000-70,000 Da) was procured from Sigma-Aldrich (St. Louis, MO, USA). The Organic reagents and solvents used acetonitrile, acetone and methanol is considered of analytical grade. Sodium dihydrogen phosphate, disodium hydrogen phosphate and trisodium phosphate used are of Analytical grade. Dialysis bag (Spectra/Por, Mw 12,000 Da) is used for drug release test.

Synthesis of Cinnamomum Zeylancium loaded PLGA Nanoparticles:

Cinnamon was pulverized in a processor and sieved to achieve a uniform size distribution. For further separation, the sieved samples were dissolved in methanol. For 72 hours, 8 gm of powder was immersed in 100 ml methanol. The mixture was evaporated to escape the solvent from the filtered extract at room temperature after it was filtered through a Whatman No.1 filter paper. The dried extract was then preserved in bottles and stored in a refrigerator until desired. The solvent evaporation approach was used to make nanoparticles. In 10 mL of organic solvent acetonitrile, 10 mg of dried extract and 50 mg of PLGA were co-dissolved. Using a homogenizer at 50 watts, the organic phase was added drop by drop to 25 mL deionized water containing 0.1 percent PVA/Pluronic F-68. To evaporate acetonitrile, the nanoparticles solution was agitated for 4 hours. After that, the suspended NPs are centrifuged for 20 minutes at 15,000 rpm (REMI, INDIA), rinsed with deionized water, and dried to obtain dry nanoparticles, which are then kept at 4 degrees Celsius for future usage.

The cinnamon-loaded PLGA nanoparticles were made using the solvent-evaporation process. During the synthesis, many factors were adjusted and evaluated in order to obtain the best formalisation conditions. The amount of biodegradable polymer used during nanoformulation, the organic to aqueous phase ratio, and drug content were all examined [4]. Throughout the series of trials, only one element has been swapped.

Optimization of Cinnamon loaded PLGA Nanoparticles

In the solvent evaporation technique, various parameters were studied for optimization of the formulated nanoparticles

A. *Sonication Time Effect:* To explain the sonication time effect on the shape and size of the nanoparticles, the time variation was done between 1min to 5 mins.

B. *Outcome of PLGA Content:* To research the effect of polymer impact, it was differed between 5 mg per ml to 10 mg per ml of organic phase and the effect of the initial amount of polymer on particle size and shape was studied.

C. *Outcome of Organic Phase Volume to Aqueous Phase Volume:* The organic volume is varied from 5 ml to 10 ml keeping aqueous phase volume constant and its outcome on size and shape of nanoparticles were studied.

D. *Effect of Drug Content:* Keeping all other variables constant, the amount of drug was varied from 1mg/ml to 2 mg/ml of organic solvent [9-10].

Figures and Tables

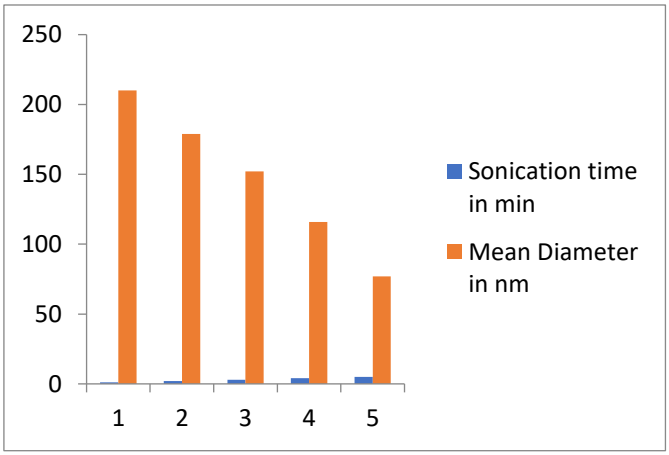

Fig. 1 Sonication time effect on the dimensions of nanoparticles

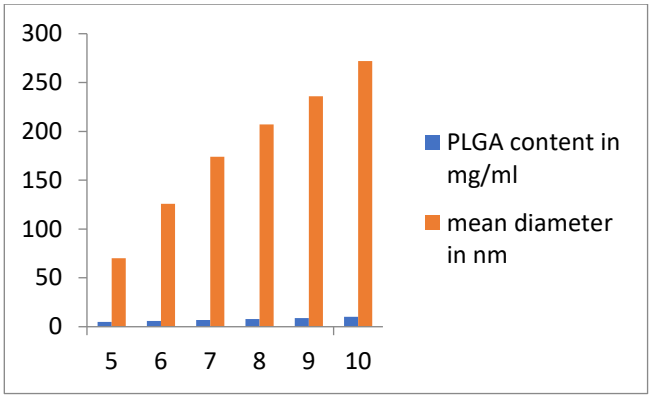

Fig. 2 Effect of polymer content on the size of NPs

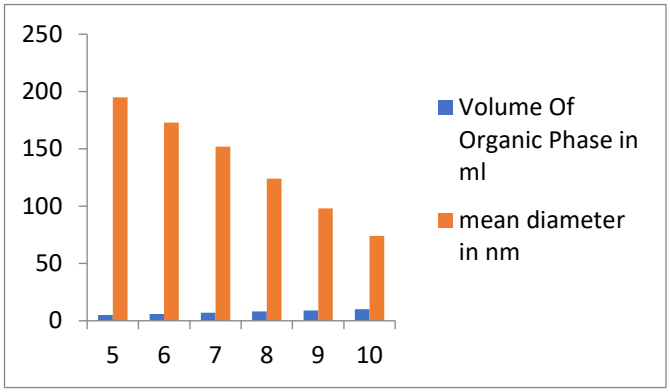

Fig. 3 Outcome of organic phase volume to aqueous phase volume

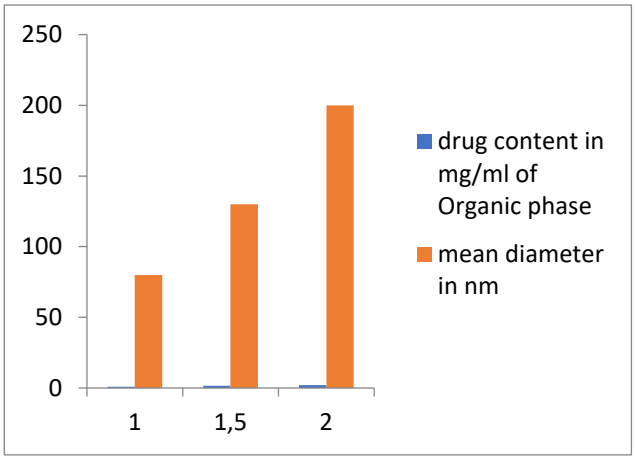

Fig. 4 Effect of amount of drug content on cinnamon NPs

II. Results

1. *Effect of Time of Sonication During Nano Formulation:* From results, it was concluded that as the time of sonication increased from 1 minute to 5 minutes, the energy applied increased and the nanoparticles decreased in size (from 210nm to 77 nm)
2. *Effect of polymer content on the size of NPs:* When PLGA was multiplied from 05 to 10 mg/ml organic phase, the particles size increased from 70 nm to around 272 nm. This was possibly attributed to increasing dispersed phase viscosity (organic phase), resulting in low dispersibility of the PLGA solution further into the aqueous phase.
3. *Outcome of organic phase volume to aqueous phase volume:* The organic phase was varied from 5-10 ml maintaining aqueous phase constant, and its effect is shown in Figure 3. It was concluded that the elevation in the organic-aqueous proportion contributes to a reduction in the dimensions of nanoparticles from 195 nm to 74 nm, and this may be due to a reduction in the agglomeration of synthesized nanoparticles.
4. *Effect of Cinnamon (Drug) Content:* The amount of cinnamon methanolic extract used varies from 1 to 2 mg / ml of organic solvent, while all other formulation variables are kept constant. The effects of increasing in the initial amount of added drug can be concluded by increasing the nanoparticles size from 80 nm to 200 nm; results are described in Figure 4.

III. CONCLUSION

Solvent evaporation is a frequently applied method for synthesizing spherical nanoparticles since it is less time consuming, easier, and requires less energy. The solvent evaporation method is used to produce a range of formulations with various surfactant compositions, drugs, polymers, and concentrations. Our findings show that using solvent evaporation improves encapsulation performance by 87.3 percent when particle size is less than 100 nanometers.

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