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PREPARATION AND CHARACTERIZATION OF AMOXICILLIN MICROSPHERE FROM NATURAL AND SYNTHETIC MATERIALS

Hamza Ishfaq^{1*} , Shahzadi Filza Hassan²

¹Department of Public Health School of Clinical Medicine and Public Health Far Eastern Federal University
Vladivostok near Russky Island Russia.

²Faculty of Pharmaceutical Sciences, Government College University Faisalabad, Punjab, Pakistan.

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ABSTRACT

Amoxicillin is an antibiotic effective in treating certain bacterial infections. When taken orally, it is absorbed slowly and minimally from the gastrointestinal tract. The aim of this study was to formulate and evaluate Amoxicillin microspheres for sustained drug delivery. A variety of synthetic and natural materials can be used to create microspheres. The natural polymer Kondagogu gum and additional components were used in this study to create different batches of Amoxicillin microspheres using the solvent evaporation process. In vitro drug release over 48 hours in phosphate buffer at pH 7.4, shape, surface morphology, particle size, polydispersity index, zeta potential, and percentage drug yield and entrapment were all taken into consideration while evaluating the produced microspheres. For six months, stability investigations were conducted on the top-performing batch. According to the results, amoxicillin microspheres may be used in place of traditional dose forms and other phytochemicals found in herbs. Considerable loading efficiency was shown by the improved formulation.

Keywords: Amoxicillin, Microspheres, Natural polymer, Kondagogu gum.

*Corresponding Author. E-mail: ishfak.kh@dvfu.ru

INTRODUCTION

Microspheres are a kind of multiparticulate drug delivery system intended for targeted administration to certain locations, enhanced stability, extended or controlled drug release, and improved bioavailability. Microspheres are defined as solid, almost spherical particles that range in size from 1 to 1000 µm and contain the medicine in either a solution or microcrystalline form. These microspheres offer good substitutes for traditional dose forms. The emulsion solvent evaporation technique, phase separation or coacervation method, emulsification diffusion method, and spray drying method are some of the frequently used techniques to create microspheres [1].

The simple production procedure of the solvent evaporation approach, which maintains pharmacological activity, has attracted a lot of attention. Compared to other preparation techniques like homogenization, sonication, and spray drying, this process has a number of advantages because it works under mild

circumstances with continual stirring and room temperature. As a result, a stable emulsion is produced, and dispersed oil droplets carrying both polymer and medicine evaporate an organic solvent to form microspheres [2].

Microspheres, also known as microparticles, can be made from a range of natural and synthetic materials. Glass, polymer, and ceramic microspheres are examples of commercially accessible choices. The density of solid and hollow microspheres varies greatly, resulting in a variety of uses. Solid microspheres have a variety of uses based on their size and composition, whereas hollow microspheres are usually employed as additives to lower a material's density. Glass microspheres have limited applications in medical technology and are mostly used as fillers to reduce weight, retro-reflectors for highway safety, and additives in cosmetics and adhesives. The primary use of ceramic microspheres is as grinding media. Microspheres can differ greatly in terms of quality,

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sphericity, homogeneity, and particle size distribution [3, 4].

Gums are naturally occurring polymers that are mostly made of carbohydrates with trace amounts of proteins and minerals. New plant-based materials are being explored and developed due to the growing desire for natural ingredients over synthetic ones. India is the origin of gum kondagogu (*Cochlospermum gossypium*), a tree exudate belonging to the Bixaceae family. Exudates from different tree species are used to make natural gums, which have a variety of uses and distinct physicochemical characteristics.

Gum arabic, gum karaya, and gum tragacanth are tree gums with commercial significance. Gum kondagogu (*C. gossypium*) and Karaya polysaccharide (*Sterculia urens*) are used as food additives. Gum kondagogu's physicochemical characteristics and toxicity assessment have already been determined. Recent studies have elucidated the morphological, structural, and physicochemical characteristics of gum kondagogu, indicating that it belongs to the group of substituted rhamnogalacturonans [5].

For these gums to be used as food thickeners, stabilizers, and emulsifiers, it is essential to comprehend their rheological characteristics. In both Gram-positive and Gram-negative bacteria, it breaks the cross-linking between linear peptidoglycan polymer chains, which are the main building blocks of cell walls. In its physiological form, the medication has ionizable groups, namely a carboxyl group and an amino group next to the amide carbonyl [6-8].

This study's primary goals were to evaluate the effects of the drug-to-polymer ratio and explore the possibility of creating a sustained-release formulation of Amoxicillin microspheres utilizing the solvent evaporation method with gum kondagogu.

MATERIAL AND METHOD

Material

Amoxicillin was procured from Highnoon Laboratories, Bhopal (MP). Kondagogu Gum procured from local pansaar store. Span 80, Tween 80, Glutaraldehyde, liquid paraffin, Toluene were purchased from Sigma Aldrich, Germany. All chemicals used were of analytical grade.

Method

Preparation of Kondagogu Gum Microspheres: Kondagogu Gum microspheres were prepared using an emulsification method, with liquid paraffin serving as the dispersing medium and glutaraldehyde as the cross-linking agent. A 2.5% w/v dispersion of Kondagogu Gum was created by mixing the gum in double-distilled water with Tween 80 at a concentration of 0.5% w/w. The drug was previously dissolved in double-distilled water.

Ten milliliters of the Kondagogu Gum solution containing the drug was added dropwise to a beaker containing 100 mL of liquid paraffin, mixed in a 50:50 ratio of light to heavy paraffin. Span 80 was added to the liquid paraffin at a concentration of 1.0% w/v. A two-blade mechanical stirrer was used to agitate the mixture at 3000–4000 rpm. 1.5 mL of toluene-saturated glutaraldehyde was added to the mixture after 30 minutes of stirring, and the mixture was stirred for four hours at 40°C and 4000 rpm [9].

The microspheres were removed from the dispersion media by centrifugation after being stirred, and they were then twice cleaned with acetone. To let the acetone evaporate, the dispersion was transferred to a petri dish. The dried drug-loaded microspheres were gathered and kept in a sealed container for later analysis when the acetone had totally evaporated [10].

Optimization of Microspheres

A number of dependent and independent process and formulation variables had to be adjusted in order to optimize the microsphere formulation. particle size, polydispersity index (PDI), and percentage drug entrapment were the basis for this optimization, which was accomplished by changing one parameter while holding the others constant. Each formulation employed a constant concentration of 1.5 mL of toluene-saturated glutaraldehyde, and the temperature was kept at 40°C [11-14].

Microsphere Characterization in Vitro

A Zetasizer was used to measure the prepared microspheres' average particle size and polydispersity index (PDI). To measure average size and PDI, the microsphere formulation was diluted with deionized water (1:9 v/v).

Shape and Surface Morphology

Scanning electron microscopy was used to examine the microspheres' surface morphology. A gold sputter module in a high-vacuum evaporator was used to coat the microspheres after they were adhered to supports with carbon glue. The scanning electron microscope was then used to examine them at 10 kV [15].

Calculating the Drug Content

A UV spectrophotometer was used to measure the amount of medication trapped in the microspheres. For 48 hours, a weighed quantity of the microspheres was incubated in PBS (pH 7.4). After centrifuging the mixture for 30 minutes at 10,000 g, the supernatant was diluted tenfold before being analyzed at λ_{max} 228 nm using a UV spectrophotometer [16].

In-vitro Drug Release from Microspheres

The drug release study was conducted in PBS (pH 7.4) for Amoxicillin-loaded Kondagogu Gum microspheres using the dialysis bag technique. A suspension of microspheres equivalent to 20 mg of

Table 1: Formulation of microsphere.

Formulation code	Drug Conc. (% w/w)	Particle Size (μm)	PDI	% Drug Entrapment
AM-1	20	48.7 $\pm$ 0.18	0.23	73.54 $\pm$ 5.2
AM-2	30	74.9 $\pm$ 0.15	0.33	82.91 $\pm$ 4.41
AM-3	45	142.3 $\pm$ 0.26	0.34	84.62 $\pm$ 3.71
AM-4	50	281.7 $\pm$ 0.61	0.31	87.91 $\pm$ 3.11

drug was placed in dialysis tubing and immersed in a beaker containing 50 mL of PBS (pH 7.4).

The dialysis bag retained the microspheres while allowing free drug to pass into the dissolution medium. The temperature was maintained at 37 ± 1 °C throughout the study. Samples were withdrawn at specified time intervals (0.5, 1, 2, 3, 4, 5, 6, 7, 8, 12, and 24 hours) and replaced with the same volume of fresh PBS (pH 7.4). The samples were then analyzed for drug concentration using the UV spectrophotometer at λ_{max} 228 nm [17].

RESULT AND DISCUSSION

As the polymer content grew from 1.0% to 3.0% w/v, the mean diameter of glutaraldehyde cross-linked microspheres produced from Kondagogu gum increased from 56.70 ± 2.15 μm to 88.15 ± 4.25 μm . To obtain the required microsphere size in this investigation, a concentration of 2.5% w/v Kondagogu gum was optimized. Because the polymer solution created larger droplets due to Concentration on average particle size and PDI of microspheres

Effect of Kondagogu Gum Concentration

Microspheres were prepared using different concentrations of Kondagogu gum, while keeping the concentrations of Span 80, Tween 80, glutaraldehyde, and stirring speed constant.

Effect of Tween 80 Concentration

Microspheres were prepared using varying concentrations of Tween 80, while maintaining constant concentrations of Kondagogu gum, Span 80, glutaraldehyde, and stirring speed.

Effect of Stirring Speed

Microspheres were prepared by varying the stirring speed, with concentrations of Kondagogu gum, Tween 80, Span 80, and glutaraldehyde held constant [21].

Effect of Span 80 Concentration

Microspheres were prepared using different concentrations of Span 80, while keeping the concentrations of Kondagogu gum, Tween 80, glutaraldehyde, and stirring speed constant.

Effect of Drug Concentration

Microspheres were prepared using varying concentrations of the drug, while maintaining

increasing viscosity, the average particle size of the microspheres increased with higher polymer concentrations. The improvement in the average particle size was caused by this increase in viscosity.

To evaluate the effect of medication concentration, mean particle size and size distribution were examined. The microspheres' size distribution and particle size did not significantly alter with different amounts of the crosslinking agent, according to earlier research, therefore this was maintained across all formulations. As the polymer drug concentration grew from 15% to 25% w/w, the encapsulation efficiency percentage climbed to 81.37 ± 3.54 . Nevertheless, entrapment efficiency did not significantly improve with additional drug concentration increases. Following matrix diffusion Higuchi release kinetics, the improved formulation (AMT-16) demonstrated an in-vitro dissolution profile of 89.67 ± 0.98 after 48 hours in PBS at pH 7.4 [18-20].

constant concentrations of Kondagogu gum, Tween 80, Span 80, and glutaraldehyde, as well as stirring speed [22].

CONCLUSION

According to the study's findings, microspheres made from kondagogu gum utilizing the emulsifying solvent evaporation method can efficiently and sustainably distribute the medication amoxicillin throughout the gastrointestinal (GIT) tract. The produced microspheres had a consistent size within an acceptable range after being optimized for a number of formulation and process variables. They had a round, smooth form. According to the matrix diffusion Higuchi release kinetics, the improved formulation showed notable loading efficiency for amoxicillin, which was released in a sustained manner.

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