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FORMULATION AND EVALUATION OF ALBENDAZOLE NANOSUPENSIONS

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ABSTRACT

Aim: The objective of present study is to improve the solubility of poorly soluble drug by nanosuspensions as a novel drug delivery system. Albendazole was chosen as a model compound because of its potential use in the treatment of helmenthiasis.

Method: Albendazole nanosuspension was prepared by solvent diffusion technique followed by sonification. Surfactant plays an important role in the preparation of nanosuspensions. Tween 60 and Sodium Lauryl Sulphate are selected as surfactant which plays a vital role in the preparation of nanosuspensions. Different concentrations are taken as a formulation variable in the preparation. The prepared nanosuspensions are evaluated for particle size, charge, morphology and solubility.

Results: Nanosuspensions had a mean size range of 168 to 223nm and zeta potential of -19 to -33.4 mV. In vitro drug release studies revealed that maximum amount of drug was released within 30 minutes (%).

Conclusion: From these results it concluded that nanosuspensions of Albendazole may represent an effective drug delivery system.

Key words: Nanosuspensions, Tween 60, Albendazole, Sodium Lauryl Sulphate

INTRODUCTION

The development of drug delivery systems improved the therapeutic and toxicological properties of existing chemotherapies and facilitated the implementation of few ones, by including the drug in technologically optimized drug delivery systems or conjugating the drugs with different polymers, it is possible to modify the pharmacokinetics and bio distribution of drugs improving the efficiency and security of the therapy [1]. Nanosuspensions are colloidal dispersions and biphasic system consisting of drug particles dispersed in an aqueous vehicle in which the diameter of the suspended particle is less than 1 μ m in size. Reduction of drug particles to nanometre range leads to an enhanced dissolution rate due to increased surface area and saturation solubility [2]. Albendazole is selected as

a model drug for formulation of nanosuspension. It is a BCS class II drug having low solubility and high permeability [3]. Thus it is challenging to enhance the solubility. Hence, the aim of the work is to improve the bioavailability of Albendazole by increasing solubility through nanosuspension as a novel drug delivery. Nanosuspension will increase in saturation solubility and consequently an increase in the dissolution rate of the drug.

MATERIALS AND METHODS

Albendazole obtained as gift sample from Tablets India, Sri City, Sullurpet, Sodium Lauryl Sulphate is purchased from Finar Chemical, Hyderabad, Tween 60 was purchased from Merck's Specialties, Hyderabad and solvents are used analytical grade.

Fourier transforms infrared studies

The stability of a formulation depends upon the compatibility of the drug with the excipients. It was significance to detect any possible physical or chemical interaction. FT-IR was a fast and reliable method to screen drug-excipients compatibility and provide maximum information regarding functional groups. The FT-IR spectrum was recorded for albendazole, SLS, Tween 60 and physical mixture. The FT-IR spectrum was recorded in the region of 4000-400cm⁻¹ [4].

Preparation of Albendazole nanosuspensions

Nanosuspensions are prepared by emulsion solvent diffusion technique followed by sonification method [2]. An accurately weighed quantity of Albendazole was dissolved in acetic acid then the solution was dispersed in the aqueous phase containing different quantity of stabilizer with stirring to form nanosuspensions. The size reduction was carried out by sonification method. The stabilizer and concentration of stabilizer are changed to desire formulation (Table.1).

Scanning Electron Microscopy observation

Scanning Electron Microscopy (SEM) was performed to evaluate the surface morphology of nanosuspension (JOEL JSM 5610, Japan). Nanosuspensions were dried on glass slide before analysis. A small amount of nanosuspensions was stuck on a double sided tap attached on a metallic sample stand then coat under argon atmosphere with a thin layer of gold. A scanning electron microscopy photograph was taken at the acceleration voltage of 20KV [7].

Drug content

Nanosuspension preparation was taken and diluted appropriately with dissolution medium. Aliquot was withdrawn and the absorbance was measured at 247 nm and the drug content was calculated from the calibration curve [8].

In vitro drug release studies

Drug release studies were carried out by using a diffusion cell, whereby a dialysis membrane with a molecular weight cut off of 12,000 – 14,000 Da separated the acceptor from the donor compartment.

Table.1: Formulations of Albendazole Nanosuspensions

Ingredient / formulation code	NS1	NS2	NS3	NS4
Albendazole (mg)	40	40	40	40
Glacial acetic acid (ml)	10	10	10	10
SLS (% w/v)	0.5	1	--	--
Tween 60 (% v/v)	--	--	0.5	1
Water (ml)	10	10	10	10

Evaluation of Albendazole nanosuspensions

Solubility study

The solubility of Albendazole was studied in various mediums like 1.2 pH Hcl buffer and Phosphate buffer pH 7.4. Albendazole was suspended separately in 5ml of different mediums at room temperature in tightly closed test tube and shaken with wrist action [5].

Particle size and Zeta potential measurement

Measurements of the mean particles diameter of the nanosuspensions are conducted with the use of a dynamic light scattering particles size analyzer (Zetasizer Ver.6.2 Malvern instruments Ltd., UK). The final particle diameter was calculated from the average of at least three measurements. The zeta potential values of the nanodispersion were measured, which measured the distribution of the electrophoretic mobility of particles [6].

The acceptor compartment was filled with 1.2 pH HCL buffer with stirring rate of 100 rpm and temperature was kept constant at 37±5°C. The sample were withdrawn at predetermined time intervals 5ml of samples from the centre of medium vessels for a period of drug concentration was determined by UV spectrophotometrically at 247 nm[8].

RESULT AND DISCUSSION:

Formulating a poorly water soluble drug has always been a challenging problem to the pharmaceutical scientist. The formula of nanosized particle can be implemented to all drug compounds belonging to biopharmaceutical classification system (BCS) classes II and IV to increase their solubility and hence partition into GI barrier having a good permeability and poor solubility. There by nanotech can be used to solve the problems associated with these conventional approaches for solubility and bioavailability [3].

Table.2: Solubility Studies of Albendazole Nanosuspensions Shown in Percentage

Solvent	Plain drug	NS1 (0.5%SLS)	NS2 (1% SLS)	NS3 (0.5% Tween60)	NS4 (1% Tween 60)
pH 1.2 (%)	29.00	74.19	93.07	83.63	64.74
pH 7.4 (%)	11.02	26.47	17.64	15.44	24.26

Interaction between the drug and excipient commonly lead to identifiable change in the FTIR spectrum. Matching up to FTIR spectrum of albendazole with physical admixture revealed no distinctive changes in the pattern of FTIR spectrum. Hence all excipient use in the formation of nanosuspensions are compatible with Albendazole.

Colloidal drug delivery system offers a number of advantages over conventional dosage form due to their particle size. Nano suspension was successfully prepared by solvent diffusion method followed by sonification method. This method is simple, reproducible, fast economic and easiest procedures for the preparation of nanosuspensions. Nanosuspensions are composed of different stabilizer and different concentration of same. Totally four different nanosuspensions are prepared and Nanosuspensions 1 (Ns1), Nanosuspensions 2 (Ns2) are made up of 0.5 and 1% Tween 60 respectively. Nanosuspension 3 (Ns3), Nanosuspension 4 (Ns4) are made up of 0.5 and 1% tween 60. Based on the solubility analysis, the optimized concentration of surfactant is 1% SLS and 0.5% for Tween 60.

It may be due to decrease the surface tension between the hydrophobic drug substance and aqueous environment as well as reduction in the particle size alternatively which increases the surface area, more quantity of dissolution medium is wetted the drug substance. The solubility of Albendazole was found to be less in phosphate buffer pH 7.4 compared with HCL buffer pH 1.2, hence the solubility study of nanosuspensions are carried out in HCL buffer pH 1.2 (Table.2).

Solubility of nanosuspensions was found more in Ns2 and Ns3 formulations compared with Albendazole alone and other formulations (pure Albendazole Ns1, Ns4).

The mean particle sizes (Z average diameter) of nanosuspensions are varied in the narrow range from 168-283nm. All the formulations showed mean size, which are below 500 nm, therefore suitable for pharmaceutical drug delivery of colloidal carrier.

The zeta potential analysis values of nanosuspensions are found in the range of -19 to -33.4 mv. PDI value was with in 0.5, which indicates that the formulation good stability. The results are tabulated in Table. 3.

Table.3: Particle Size and Charge Data of Nanosuspensions

Parameters	NS1	NS2	NS3	NS4
Particle size (nm)	283	168	280	264
PDI	0.45	0.39	0.22	0.34
Zeta potential (mV)	-29.2	-33.4	-32.8	-19.6

The Scanning Electron Microscopy (SEM) characterisation revealed that the nanosuspensions are spherical in shape with a relative smooth surface (Shown in Figure.1). The size of the nanosuspensions is obtained in the SEM study which also support with the particle size analysis report.

Figure.1: SEM Image of Formulation NS3

Drug content of the prepared different formulations Ns1, Ns2, Ns3, Ns4 were found to be 94.08%, 96.54%, 95.54%, 92.22%. All formulations are released the drug within 30 minutes, among 4 formulation Ns2, shows maximum drug release. The results are tabulated in Table.4.

Table.4: In-Vitro Diffusion Studies of Albendazole Nanosuspensions

TIME (min)	NS1	NS2	NS3	NS4
	%CDR	%CDR	%CDR	%CDR
0	0	0	0	0
10	5.80	12.14	22.93	26.97
15	69.74	76.88	75.54	60.70
30	94.42	102.53	96.72	90.38

Conclusion

Solvent diffusion method has been employed to produce nanosuspensions of Albendazole. Based on the data mention in results, it is concluded that the nanosuspensions of Albendazole increase the bioavailability through enhancing the solubility by size reduction and also effective treatment for the helmenthiasis.

CONFLICT OF INTEREST:

NIL

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