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Formulation and Evaluation Studies of Glimepiride Loaded Niosomes

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Abstract

The management of infectious diseases and immunization has experienced a transformative change in recent years. The advent in biotechnology and genetic engineering has created a number of disease-specific biological. However the focus on successfully delivering thesebiological is a challenge. Niosomes are vesicles made of non-ionic surfactants that are biodegradable, non-toxic, more durable, and less costly. In the present work, Glimepiride-entrapped niosomes were produced utilizing an ether injection method with various cholesterol (CHOL) and Span-60 ratios (1:1, 1:2, and 1:3). In this analysis, the ether injection approach to insert Glimepiride into niosomes was investigated. In the case of ether injection process, the prepared niosomesranges from 0.662 to 1.713 µm in size. In-vitro release tests on Glimepiride niosomes displayed 98.3% release for formulations prepared with CHOL: Span-60 (1:1) and a release duration of 0 to 24 hours. It has been observed that with the increase in concentration of Span-60, the order of encapsulation quality had improved. The impact of varying non-ionic surfactant and cholesterol composition on properties such as zeta potential, drug quality, vesicle scale, and drug release were tested in an assessment analysis. Based on the findings of this study, it is possible to infer that the developed noisome formulation of Glimepiride has considerable potential in the treatment of diabetes due to its prolonged releaseprofile.

Keywords: Glimepiride, SEM, dissolution, Cholesterol, Span-60, Niosomes, In-vitro drug release.

1. Introduction

In recent years, medication distribution with a regulated rate and guided delivery has been the topic of prime research in pharmaceutical industry. The application of nanotechnology to medicine has resulted in the creation of multifunctional nano-particles that can be filled with various drugs and serve as drug carriers. Nano-carriers provide a promising path to drug distribution, with features such as drug safety from deterioration and cleavage, controlled release

and in the case of selective delivery methods, drug molecule delivery to the target sites [1].Niosomes reflect a modern method of drug distribution that encapsulates drugs into a vesicle. Niosomes in their structural properties are biodegradable, biologically compatible and versatile. Niosomes are more robust than other new techniques of therapeutic supply [2]. They aim at delivery and attainment of the active component at a pace based on the body's requirements during the therapy cycle[3]. It may be used as an amphiphile and lipophile medication handler. Goal and managed supplies of medicines for cancer, viral infections, cancer and other microbial diseases were typically assessed with respect to niosomes[4]. Glimepiride is the only sulphonyl urea in 3rdgeneration that reduces bloodglucose levels in both stable and type-II patients. Glimepiride is drained entirely from the GI tract after oral administration (100 percent) [5-6]. Further it also requires regular administration to sustain plasma concentration because of its short biological half-life. In noisomes, the amphiphilic vesicles are non-ionic surfactants including Span-60, which are typically cholesterol-stabilized. Off the various approaches, Ether injection is a popular form of niosomes preparation and is used to formulate niosomes due to its processing simplicity, without impacting drug action [7].

Type 2 diabetes is characterized by insulin resistance and gradual cell death, thus cell secretagogin is beneficial in preserving adequate glycemic regulation. Glimepiride is an insulin release inducer that induces second-generation insulin release from pancreatic cells. Furthermore, several additional pancreatic mechanisms have been discoveredto be active. Individuals of Type 2 diabetes mellitus that are unable to regulate their glucose levels by nutritional and lifestyle adjustments are offered monotherapy. In patients not properly tissue-alone controlled, it may be combined with other antihyperglycemic agents, such as metformin and insulin. The effective dose range for elderly patients and patients who have renal or liver problems is 1-8 mg/day; nonetheless, there is a substantial variation of four to eight mg/day. Glimepiride was usually associated in clinical trials with a reduced risk of hypoglycaemia and a weight increase relative with other sulfonylureas. In coronary disease patients the lack of an adverse impact on ischemic pre-conditioning should be reinforced. This decreases the level of fasting plasma glucose and the amount of haemoglobin after cutaneous glucose and is an inexpensive therapy for type-2diabetes.

The objective of the present study was to prepare and evaluate Glimepiride loaded niosomes and to study its impact on varying non-ionic surfactant and cholesterol composition on properties such as zeta potential, drug quality, vesicle scale etc.

2. Materials andMethod

Glimepiride was obtained as gift sample from medley Pharmaceuticals Ltd, Daman Unit, Andheri East, Mumbai, India. Span 60 was procured from Central Drug House Pvt. Ltd. New Delhi India. Cholesterol was purchased from Loba Chemicals Pvt. Ltd, Mumbai India. All the chemicals were of analytical grade.

2.1 Fabrication of Niosomes:

The surfactant and lipid was dissolved in appropriate organic solvent. The organic phase was then applied to the drug-containing aqueous phase. Thus, a dissolved organic surfactant solution was injected into a preheated 15 mL phosphate buffer at 1 mL/min resulting to vesicle

formulation. Different formulation designs are given in Table 1.

Table 1: Formulations design of Glimepiride niosomes.

Formulation	Drug (mg)	Span-60 (mg)	Cholesterol (mg)	Phosphate Buffer (ml)
F1	10	10	5	15
F2	10	20	10	15
F3	10	30	15	15
F4	10	40	20	15
F5	10	50	25	15

2.2 Characterization of prepared Niosomes

2.2.1 Surface morphology

The SEMstudies were performed to determine the surface morphology of theoptimizedniosomes formulation [9].The samples were completely dried in the vacuum dryer. Fig. 1 shows the SEM of the optimized formulation.

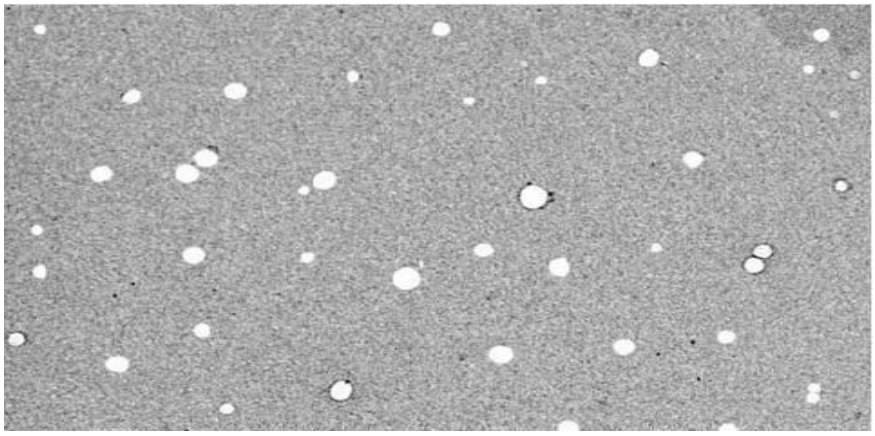


Fig.1 SEM studiesof optimized niosomes.

2.2.2 Vesicle size analysis

A corresponding eyepiece micrometer was used to measure the height of the vesicle. Roughly 300 niosomes were weighed, averaged, and the distribution spectrum was estimated, along with the medium diameter, and shown in Table 2.

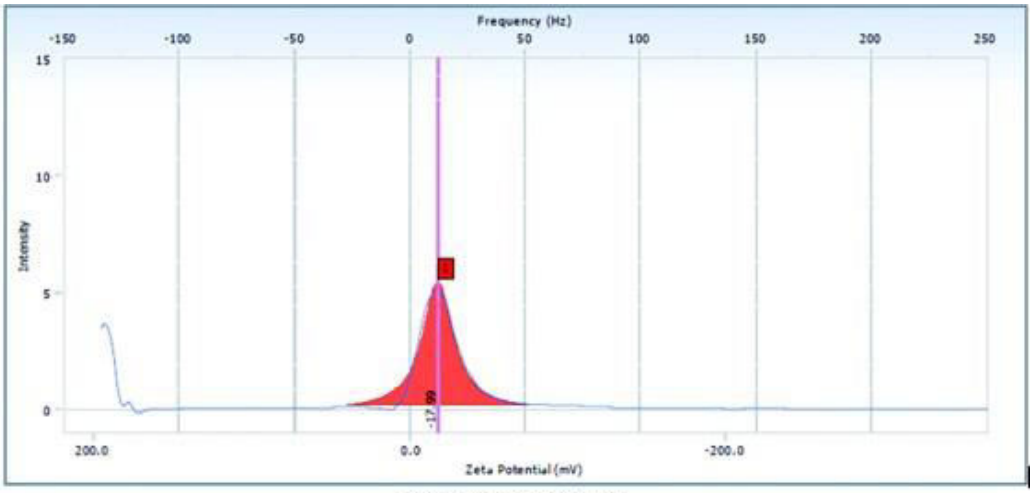
Table 2: vesicle size analysis of Glimepiride niosomes

Formulation	Vesicle size (µm)
F1	0.662
F2	1.878

F3	1.479
F4	1.519
F5	1.713

2.2.3 Zeta potential

Zeta-sizer has been used to assess the zeta potential of the niosomes. The zeta analyzer consists mostly of a laser used as an illumination medium to illuminate the collection of particles. These light splits to create an incident and a reference beam to measure zeta potential. The laser beam event travels across the centre of the samples and is detected at an angle of around 13° at the dispersed light. Zeta potential was recorded and mentioned in Fig. 2.



Measurement Results

Zeta Potential	: -17.99	(mV)	Doppler shift	: 13.79	(Hz)
Mobility	: -1.637e-004	(cm²/Vs)	Base Frequency	: 120.8	(Hz)
Conductivity	: 0.0169	(mS/cm)	Conversion Equation	: Smoluchowski	
Zeta Potential of cell			Diluent Properties		
Upper Surface	: -55.41	(mV)	Diluent Name	: WATER	
Lower Surface	: -20.04	(mV)	Temperature	: 30	(°C)
Cell Condition			Refractive Index	: 1.3330	
Cell Type	: Flow Cell		Viscosity	: 0.8793	(cP)
Avg. Electric Field	: -21.19	(V/cm)	Dielectric Constant	: 78.0	
Avg. Current	: -0.07	(mA)			

Fig.2 Zeta potential of optimized niosome

3. Result and discussion

Five formulations of Glimepiride niosomes were prepared using non-ionic surfactants (Span-60), along with cholesterol in different composition (5, 10, 15, 20 and 25 mg) with the concentration of the drug being constant as 10mg.

3.1 Drug Entrapment Efficiency

Entrapped Glimepiride niosomes were taken after dialysis and drug entrapment efficiency was calculated. The dialysis was done by inserting noisome dispersion in a dialysis bag and dipping it in a beaker containing 400 ml of PBS with a pH of 7.4. The beaker was then mounted on a

magnetic stirrer that operated for 4 hours at a pace of 80-120 rpm. The fluid within the receptor compartment was then checked for un-entrapped Glimepiride using a UV spectrophotometer at 275 nm. The niosomes was determined by dividing the total amount of drug added by the amount of un-entrapped drug found by the total amount of drug added **[12].** The results are given in Table 3.

$$\text{Drug Entrapment efficiency (\%)} = \frac{\text{Amount of ' Glimepiride in nanoparticle} \times 100}{\text{Amount of ' Glimepiride in formulation}} \quad \ldots\ldots$$

Table 3: Entrapment efficiency

Formulation code	Entrapment efficiency %
F1	85.2
F2	87.2
F3	84.3
F4	84.2
F5	82.4

3.2 Drug content

The UV spectrophotometric approach was used to assess the quality of Glimepiride in niosomes. A 10 mL of methanol dissolved in niosomes comprising of 10 mg of medication equivalent were taken for testing. UV spectrophotometers with blank calculation at λ_{max} 267 nm were measured and the drug amount was calculated after sufficient dilution absorption. The % drug content of Glimepiride in different niosome formulations are shown in the Table 4.

Table 4: Formulated noisome drug content

Code	% drug content
F1	55.7
F2	86.4
F3	60.8
F4	69.5
F5	75.8

3.3 *In vitro* drug release studies

For *in-vitro* studies, a plastic tube with a 2.5 cm inner diameter, accessible on both ends consists of a diagnostic cell device was used wherein one end of the tube was attached to the membrane of dialysis to act as a donar. In a beaker of 100 mL of phosphate buffer pH 7.4, with a moderate velocity preserving a 37°C temperature, the niosome of 50 mg of the medication was taken. 1 ml of samples has regularly been removed while replacing the same medium length. UV Spectrophotometer tested samples with a pH of 7.4 phosphate buffer (267 nm) as a blank and total proportion of medications published is computed and computed with time (t) displayed in the figure3, while the % of drug release in different formulations are mentioned in Table 5.

Table 5: Drug release of different formulation of Niosomes

TIME (HRS)	F1	F2	F3	F4	F5
0	0	0	0	0	0
1	16.4	15.4	13.8	12.9	18.4
2	33.2	30.5	29.8	28.7	30.4
3	40.5	45.5	42.2	44.1	39.9
4	47.8	57.6	49.7	51.1	52.6
6	55.8	68.8	59.2	58.8	63.2
8	68.8	75.5	70.1	69.9	73.3
10	76.4	82.7	79.9	78.5	79.4
12	84.7	90.2	88.9	85.5	86.8
24	92.1	98.3	95.1	91.8	96.3

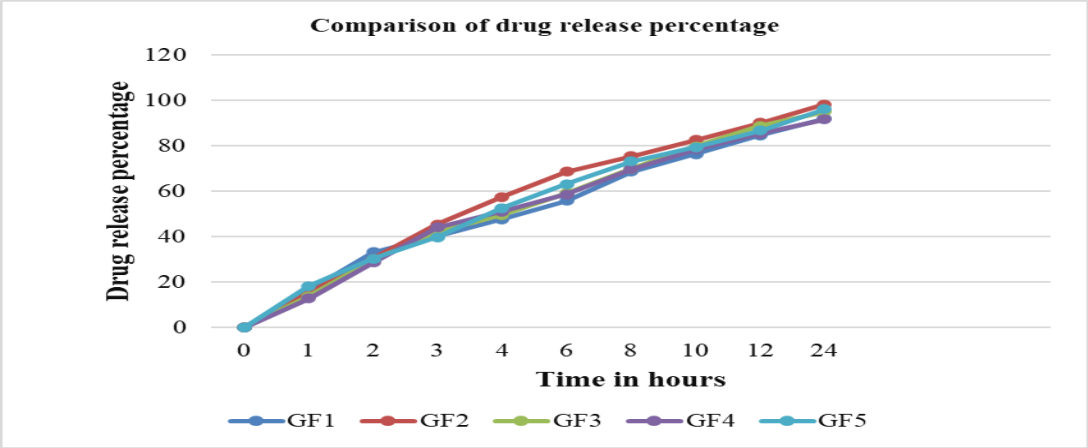


Figure 3: Cumulative % release of Glimepiride niosomes.

4. Conclusion

The ether injection procedure is an easy and effective method for creating feature niosomes for various drugs such as hydrophobic and amphiphilic drugs. The research by SEM has demonstrated the discretion of niosomes generated using ether's injection technique. Constant concentrations of the glimepiride drugs was investigated in the pharmaceutical material. It has been observed that as the polymer concentration in the mixture was improved, the drug content had gradually risen. The maximum frequency of entanglement in GF-2 formulation was observed to be 87.2%. For the study of drug-polymer interactions, the FT-IR spectrophotometer was used. It was observed that there was no noticeable difference in the IR spectrum of pure and medicinal niosomes. A pure Glimepiride thermogram was obtained by using calorimetry for differ scanning had revealed a sharp plateau with an endotherm of 174°C. This showed that there is no link between medication and polymer. The formulated niosomes had a zeta potential of -17.99 mV, which conveyed moderately stable nature. The difference in release rate is thought to be due to the surfactant's lipophilicity. The variation in release rate is thought to be due to the surfactant's

lipophilicity. Based on the results of this report, Glimepiride niosomes may be inferred as a promising tool for delivery. The results of the above assessment also indicate that the F2 formulation is continuously published. This attempt makes Glimepiride noisy and an acceptable form of appropriate surfactant, which has the benefits of lowering the dosage, decreasing dosing frequency, overcoming resistance to current single drug regimen therapy with increased stabilization.

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