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# Design and development of gastroretentive floating microspheres of glipizide

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## ABSTRACT

*The floating or hydro dynamically controlled drug-delivery systems are useful to increase the retention time of the drug-delivery systems for more than 12 h. Unfortunately floating devices administered in a single unit form (such as hydrodynemially balanced system)are unreliable in prolonging the GRT owing to their 'all-or–nothing" emptying process and thus they may causes high variability in bioavailability and local irritation due to large amount of drug delivered at a particular site of the GIT. Glipizide is a second-generation sulfonylurea having short biological half-life (3.4 ± 0.7 hours). Moreover, the site of absorption of glipizide is in the stomach[2]. The present study reports the development of drug-loaded floating microspheres of acrycoat S100 (acrylic resin) with an internal hollow structure by a solvent diffusion and evaporation method. The yield of microspheres depended on the diffusion rate of alcohol in the organic phase. The mixing ratio of components in the organic phase affected the size and the yield of Microspheres. Direct introduction of the organic phase into the aqueous phase though a glass tube also significantly improved the yield by avoiding the contact of organic phase with the surface of water. The microspheres produced exhibited good encapsulation efficiencies and micromeritic properties for formulation as single-unit dosage forms. The microspheres were having lower densities. Encapsulation efficiency of microspheres is around 90%. This is because of the low solubility of glipizide in aqueous solution*

**Key Words:** Gipizide, Acrycoat, Microspheres.

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## INTRODUCTION

The floating or hydro dynamically controlled drug-delivery systems are useful to increase the retention time of the drug-delivery systems for more than 12 h. Unfortunately floating devices administered in a single unit form (such as hydrodynemially balanced system)are unreliable in prolonging the GRT owing to their 'all-or–nothing" emptying process and thus they may causes high variability in bioavailability and local irritation due to large amount of drug delivered at a

particular site of the GIT[1]. Glipizide is a second-generation sulfonylurea having short biological half-life (3.4 ± 0.7 hours). Moreover, the site of absorption of glipizide is in the stomach[2]. The present study reports the development of drug-loaded floating microspheres of acrycoat S100 (acrylic resin) with an internal hollow structure by a solvent diffusion and evaporation method. The yield of microspheres depended on the diffusion rate of alcohol in the organic phase. The mixing ratio of components in the organic phase affected the size and the yield of Microspheres. Direct introduction of the organic phase into the aqueous phase though a glass tube also significantly improved the yield by avoiding the contact of organic phase with the surface of water. The microspheres produced exhibited good encapsulation efficiencies and micromeritic properties for formulation as single-unit dosage forms. The microspheres were having lower densities. Encapsulation efficiency of microspheres is around 90%. This is because of the low solubility of glipizide in aqueous solution

## MATERIALS AND METHODS

### Materials used in present investigation

| | |
|---|---|
| Glipizide | : Alembic LTD. |
| Acrycoat S100 | : Corel Pharma Chem., Ahmedabad, India |
| Iso propyl alcohol | : Ranchem ltd. |
| Dichloromethane | : S.D Fine Chemicals Ltd., Mumbai, India |
| Ethanol | : S.D Fine Chemicals Ltd., Mumbai, India |
| Hydrochloric Acid | : Qualigen Chemicals, India. |
| Methanol | : Merck, India |
| Sodium Chloride | : S.D Fine Chemicals Ltd., Mumbai, India |
| Acrycoat L100 | : Corel Pharma Chem., Ahmedabad, India |
| Acryflow | : Corel Pharma Chem., Ahmedabad, India |
| HPMC | : S.D Fine Chemicals Ltd., Mumbai, India |
| Ethyl Cellulose | : S.D Fine Chemicals Ltd., Mumbai, India |
| Tween 20 | : Loba Chemie Pvt Ltd., Mumbai, India |
| GMS (Glyceryl Mono Stearate) | : Loba Chemie Pvt Ltd., Mumbai, India |

**Experimentation :**

**Preparation of standard curve of Glipizide** Glipizide (100 mg) was dissolved in minimum amount of methanol and volume is made up to 100 ml with 0.1 N HCl in volumetric flask. The UV maxima of Glipizide solution was found to be 276 nm. The standard curve was generated for entire range from 10 to 35 mcg/ml. Five ml of stock solution (1 mg/ml) was further diluted with 0.1 N HCl to 50 ml.

This solution (100 mcg/ml) was further diluted with 0.1 N HCl to obtain solution of 10 mcg/ml to 35 mcg/ml. Absorbance of each solution was measured at 276 nm using Shimadzu 1700 UV/Vis double beam spectrophotometer 0.1 N HCl as a reference standard. The experiment was preformed in triplicate and based on average absorbance, the equation for the best line was generated. The results of standard curve preparation are shown in Table 5.8 & Fig. 5.1

**Preparation of Acrycoat S100 microspheres of Glipizide[3]**

Glipizide and Acrycoat S100 were dissolved in a mixture of alcohol and Dichloromethane .This mixture was poured in a 500 ml water containing PVA maintained at specified temperature with stirring. Stirring was continued for 1 h. to allow the volatile solvent to evaporate. The microspheres formed were filtered, washed with water and dried in oven overnight at temperature $40^0$ C.

**Preliminary trials (Effect of various parameters on Size, yield and floating of microspheres)**

**Method of introducing polymer solution**

One modified method was used to introduce polymer solution to aqueous solution. In this method the glass tube immersed in an aqueous phase was used and the polymer solution was introduced though tube below the water surface.

**Effect of amount of Alcohol (Ethanol & IPA)**

Different ratio of ethanol & IPA were studied ( batches B1 to B13) for the preparation of Acrycoat S100 microspheres. Changes in alcohol composition in preparation of Acrycoat S100 Microspheres are shown in Table 5.1.Results of these trials are depicted in Table 5.9

In batches B1 to B13 the following parameters were kept constant.

Amount of polymer 1 gm, Amount of Glipizide 0.5 gm, Stirring speed 300 rpm, concentration of PVA 0.5 %, temperature $25^0$C and diameter of glass tube 5 mm

**Table 1 Changes in Alcohol composition in preparation of Acrycoat S100 Microspheres**

| Batch no. | DCM (ml) | Ethanol (ml) | IPA (ml) |
|---|---|---|---|
| B1 | 5 | 5 | 0 |
| B2 | 5 | 8 | 0 |
| B3 | 5 | 10 | 0 |
| B4 | 5 | 12 | 0 |
| B5 | 5 | 7.5 | 0 |
| B6 | 5 | 0 | 5 |
| B7 | 5 | 0 | 10 |
| B8 | 5 | 0 | 7.5 |
| B9 | 5 | 2 | 8 |
| B10 | 5 | 4 | 6 |
| B11 | 5 | 6 | 4 |
| B12 | 5 | 8 | 2 |
| B13 | 5 | 9 | 1 |

**Effect of amount of DCM**

Effect of amount of DCM on morphology, yield and floating of floating microspheres by varying amount of DCM from 3-9 ml while keeping amount of Ethanol & IPA constant. Changes in amount of DCM in preparation of Acrycoat S100 Microspheres are depicted in Table 5.2 & Results of these trials are depicted in Table 5.10

In batches C1 to C4 the following parameters were kept constant.

Amount of Glipizide 0.5 gm, Stirring speed 300 rpm, and Concentration of PVA 0.5 %, Temperature $25^0$C and Diameter of glass tube 5 mm.

## Preparation of Acrycoat S100 Microspheres

**Table2 Changes in amount of DCM in preparation of Acrycoat S100 Microspheres**

| Batch No. | Ethanol (ml) | IPA (ml) | DCM (ml) | Acrycoat S100(gm) |
|---|---|---|---|---|
| C1 | 4 | 6 | 3 | 1 |
| C2 | 4 | 6 | 5 | 1 |
| C3 | 4 | 6 | 7 | 1 |
| C4 | 4 | 6 | 9 | 1 |

## Effect of amount of Acrycoat S100

The effect of amount of Acrycoat S100 in organic phase on the formation of microspheres was evaluated with 25ml of solvent mixture (Ethanol: IPA: DCM= 4:6:5). Changes in amount of Acrycoat S100 in preparation of Acrycoat S100 Microspheres are depicted in Table 5.3 & Results of these trials are depicted in Table 5.11

**Table 3 Changes in amount of Acrycoat S100 in preparation of Acrycoat S100 Microspheres**

| Batch No. | Ethanol (ml) | IPA (ml) | DCM (ml) | Acrycoat S100(gm) |
|---|---|---|---|---|
| C5 | 4 | 6 | 5 | 0.5 |
| C6 | 4 | 6 | 5 | 1 |
| C7 | 4 | 6 | 5 | 1.5 |

In batches C5 to C7the following parameters were kept constant.

Stirring speed 300 rpm, Concentration of PVA 0.5 %, Temperature $25^0$C and Diameter of glass tube 5 mm

## Effect of rotation speed

Rotation speed affect the yield and size distribution of microspheres. Rotation speed studied was 200- 500 rpm. Changes in rotation speed in preparation of Acrycoat S100 Microspheres are depicted in Table 5.4 & Results of these trials are depicted in Table 5.12

**Table 4 Changes in rotation speed in preparation of Acrycoat S100 Microspheres**

| Batch No. | Ethanol (ml) | IPA (ml) | DCM (ml) | Acrycoat S100(gm) | Rotation Speed |
|---|---|---|---|---|---|
| C8 | 4 | 6 | 5 | 1 | 200 rpm |
| C9 | 4 | 6 | 5 | 1 | 250 rpm |
| C10 | 4 | 6 | 5 | 1 | 300 rpm |
| C11 | 4 | 6 | 5 | 1 | 500 rpm |

In batches C8 to C11 the following parameters were kept constant.

Concentration of PVA 0.5 %, Temperature $25^0$C and Diameter of glass tube 5 mm

**Effect of emulsifier concentration on morphology of microspheres**

PVA was used as an emulsifier (0.5-1.5%) in the present investigation to minimize aggregation of the microspheres. Changes in emulsifier concentration in preparation of Acrycoat S100 Microspheres are depicted in Table 5.5 (Batches C12 to C14) & Results of these trials are depicted in Table 5.13

In batches C12 to C14 the following parameters were kept constant.

Temperature $25^0$C and Diameter of glass tube 5 mm

**Table 5 Changes in emulsifier concentration in preparation of Acrycoat S100 Microspheres**

| Batch No. | Ethanol (ml) | IPA (ml) | DCM (ml) | Acrycoat S100(gm) | Emulsifier Concentration |
|---|---|---|---|---|---|
| C12 | 4 | 6 | 5 | 1 | 0.5% PVA |
| C13 | 4 | 6 | 5 | 1 | 1% PVA |
| C14 | 4 | 6 | 5 | 1 | 1.5% PVA |

**Effect of temperature on Morphology**

The influence of various preparation temperatures: 10, 20, 30, and $40^0$C on particle size and morphology were evaluated (Batches C15 to C18). Changes in temperature in preparation of Acrycoat S100 Microspheres are depicted in Table 5.6 & Results of these trials are depicted in Table 5.14.

In batches C15 to C18 the following parameters were kept constant.

Diameter of glass tube 5 mm.

**Effect of diameter of glass tube**

Diameter of glass tube, with which polymer solution was poured to aqueous solution, also affects the size of the microspheres. Two different diameters i.e. 5 mm & 7 mm were used in this study. Changes in diameter of glass tube in preparation of Acrycoat S100 Microspheres are depicted in Table 5.7 & Results of these trials are depicted in Table 5.15

**Table 6 Changes in temperature in preparation of Acrycoat S100 Microspheres**

| Batch No. | Ethanol (ml) | IPA (ml) | DCM (ml) | Acrycoat S100(gm) | Temperature |
|---|---|---|---|---|---|
| C15 | 4 | 6 | 5 | 1 | $10^0$C |
| C16 | 4 | 6 | 5 | 1 | $20^0$C |
| C17 | 4 | 6 | 5 | 1 | $30^0$C |
| C18 | 4 | 6 | 5 | 1 | $40^0$C |

**Table 7 Changes in diameter of glass tube in preparation of Acrycoat S100 Microspheres**

| Batch No. | Ethanol (ml) | IPA (ml) | DCM (ml) | Acrycoat S100(gm) | Diameter of glass tube |
|---|---|---|---|---|---|
| C19 | 4 | 6 | 5 | 1 | 5 mm |
| C20 | 4 | 6 | 5 | 1 | 7 mm |

## Characterization of Glipizide microspheres

### Determination of mean particle size

The particle size was measured using an optical microscope, and the mean particle size was calculated by measuring 200 particles with the help of a calibrated ocular micrometer[6]. A small amount of dry microspheres was suspended in purified water (10 ml). A small drop of suspension thus obtained was placed on a clean glass slide. The slide containing acrycoat microspheres was mounted on the stage of the microscope and diameter of at least 100 particles was measured using a calibrated optical micrometer. The mean particle size was calculated and results are given in Fig. 5.3

### Percentage Buoyancy [6]

The floating test was carried out to investigate the floatability of the prepared microspheres. To assess the floating properties, the microspheres were placed in 0.1 N HCl containing 0.02% v/v Tween 20 surfactant (pH 2.0, 100 ml) to simulate gastric conditions. The use of 0.02% Tween 20 was to account for the wetting effect of the natural surface-active agents, such as phospholipids in the GIT. The mixture was stirred at 100 rpm in a magnetic stirrer. After 12 h, the layer of buoyant microparticles was pipetted and separated by filtration. Particles in the sinking particulate layer were separated by filtration. Particles of both types were dried in an oven at $65^0$ C until constant weight. Both the fractions of microspheres were weighed and buoyancy was determined by the weight ratio of floating particles to the sum of floating and sinking particles. Despite the solution being stirred for 12 h, the hollow microspheres still floated, indicating that the microspheres exhibit an excellent buoyancy effect. Density values of the microspheres (<1.000 g/cm$^3$) were less than that of the gastric fluid (~1.004 g/cm$^3$), further supporting the floating nature. The in vitro floating test was conducted on the drug-loaded microspheres. Results of Percentage buoyancy of different batches is shown in Fig. 5.4

$$\% \text{ Buoyancy } = \left(\frac{W_f}{W_f + W_s}\right) \times 100 \qquad \text{-----5.1}$$

### Incorporation Efficiency (IE)[8].

To determine the incorporation efficiency, 10 mg microspheres were thoroughly triturated and dissolved in minimum amount of methanol. The resulting solution was made up to 100 ml with 0.1 N HCl and filtered. Drug content was analyzed spectrophotometrically at 276 nm. The percentage incorporation efficiency and percentage drug loading were calculated using eq. 5.2 & 5.3 given below. Results of Drug Loading and Incorporation Efficiency are depicted in Fig. 5.5

$$\% \text{ Drug loading} = \frac{\text{Actual drug content}}{\text{Weight of microspheres}} \text{ X } 100 \qquad \text{-----5.2}$$

$$\% \text{ Incorporation efficiency} = \frac{\text{Actual drug content}}{\text{Theoretical drug content}} \times 100 \quad \text{-----5.3}$$

**Production yield**

Production yield of Hollow microspheres containing a drug was determined by the weight ratio of the dried Hollow microspheres to the loading amount of the drug and Polymer[9]. Production yield was calculated using eq.5.4 & results are depicted in Fig. 5.6

$$\% \text{ Production Yield} = \frac{\text{Total mass of microspheres}}{\text{Total mass of raw materials}} \times 100 \quad \text{-----5.4}$$

**Micromeritic Properties of Hollow Microspheres**

The microspheres are characterized by their micromeritic properties, such as particle size, tapped density, compressibility index, true density, and flow property. The tapping method was used to calculate tapped densities[11] and percentage compressibility index[6]. Tapped densities and percentage compressibility index can be calculated using eq. 5.5 & 5.6.

$$\text{Tapped Density} = \frac{\text{Mass of microspheres}}{\text{Volume of microspheres after tapping}} \quad \text{-----5.5}$$

$$\%\text{Compressibility Index} = \left[1 - \frac{V}{V_0}\right] \times 100 \quad \text{-----5.6}$$

Here, V and $V_0$ are, respectively, the volumes of the sample after and before the standard tapping.

The angle of repose $\phi$ of the microspheres, which measures the resistance to particle flow, was measured using fixed funnel method and calculated as per following eq. 5.7

$$\tan\theta = \frac{2H}{D} \quad \text{-----5.7}$$

Where 2H/D is the surface area of the free-standing height of the microsphere heap that is formed after making the microspheres flow from the glass funnel. Results of micromeritics properties like Angle of Repose, Compressibility Index, Tapped Density and True Density are shown in Table 5.16

**FTIR spectra study**

Samples of glipizide, acrycoat S100, and microspheres were crushed differently with KBr to make KBr pallets of (a) Glipizide; (b) Acrycoat S100; (c) Acrycoat S100 microsphere of glipizide[10] and then their IR spectra were recorded over the region 400 to 4000 $cm^{-1}$. IR spectra of test samples are given in Fig 5.7

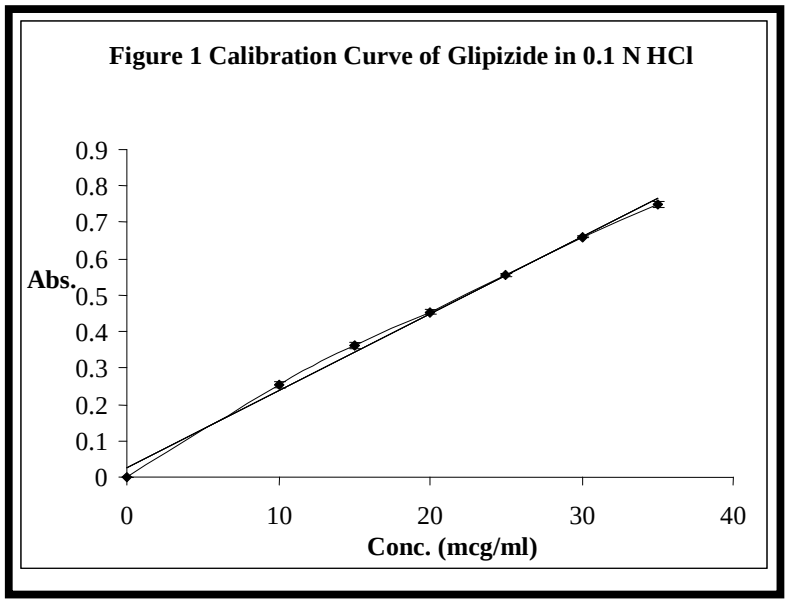
## RESULTS AND DISCUSSION

### Preparation of Standard curve of Glipizide

Standard curve was prepared according to procedure given in 5.2.1. The method obeys Beer's Law in the concentration range of 10 to 35 mcg/mL. The results of standard curve preparation are shown in Table 5.8 and Figure 5.1.

**Table 5.8 Standard curve of Glipizide in 0.1 N HCl**

| Sr. No. | Concentration (mcg/ml) | Absorbance | | | |
|---|---|---|---|---|---|
| | | I | II | III | Mean |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 2 | 10 | 0.252 | 0.267 | 0.246 | 0.255±0.011 |
| 3 | 15 | 0.370 | 0.360 | 0.356 | 0.362±0.007 |
| 4 | 20 | 0.465 | 0.456 | 0.440 | 0.454±0.013 |
| 5 | 25 | 0.555 | 0.563 | 0.549 | 0.556±0.007 |
| 6 | 30 | 0.661 | 0.670 | 0.649 | 0.660±0.011 |
| 7 | 35 | 0.755 | 0.754 | 0.741 | 0.750±0.008 |
| **sorption** = 0.0212X + 0.0258<br>**Correlation Coefficient** = 0.9959 | | | | | |




**Preliminary trials (Effect of various parameters on Size, yield and floating of microspheres)**

### Method of introducing polymer solution

When polymer solution was directly introduced in to aqueous solution, the high surface tension of water caused the aggregation of acrycoat S100 on the surface of aqueous phase. To minimize the contact of polymer solution with the air water interface this modified method was used.

**Effect of Alcohol (Ethanol & IPA)**

When ethanol alone was used for preparation of acrycoat S 100 microspheres, fiber like aggregates was formed around the stirrer. This is because of the fast diffusion of the ethanol in the water before formation of the droplets.

To control the diffusion rate of ethanol, IPA was added to the polymer solution. When ethanol was totally replaced with IPA microspheres was with good sphericity and narrow size distribution but it was taking more time e.g. 3-4 h. for evaporation of the solvent. So co solvents of the ethanol and IPA in different ratios were studied in the preparation of acrycoat S 100 microspheres.

From Table 9, the ratio 4:6:5 of Ethanol: IPA: DCM seems to be best among all with respect to narrow size distribution and % yield. So this ratio was taken for further study.

**Effect of amount of DCM**

From table 5.10, it can be seen that as the amount of DCM increases, the average size of microspheres was increased. As ethanol and IPA preferentially diffused out of emulsion droplets, DCM becomes major constituent of internal organic phase. The Acrycoat S 100, not being soluble at the interphase between Dichloromethane and water, started to solidify around the DCM-rich emulsion droplets and the volume of DCM within the droplets becomes a size determining factor. The content of DCM also affected the morphology of microspheres and best results with spherical shape were obtained when the ratio of alcohol to DCM was 2:1.Results of these trials are shown in Table10.

**Table 9 Effect of alcohol composition on the particle size, yield and floating of microspheres**

| Batch no. | Mean particle size (µm) | %Yield | % Floating | Incorporation Efficiency |
|---|---|---|---|---|
| B1 | 520±40 | 85 | 56 | 84 |
| B2 | 590±50 | 94 | 58 | 86 |
| B3 | 235±23 | 95 | 49 | 83 |
| B4 | 184±21 | 89 | 48 | 90 |
| B5 | 444±50 | 75 | 57 | 91 |
| B6 | 410±90 | 72 | 58 | 82 |
| B7 | 336±86 | 91 | 55 | 87 |
| B8 | 489±55 | 69 | 59 | 89 |
| B9 | 390±67 | 91 | 54 | 84 |
| B10 | 292±10 | 96 | 58 | 92 |
| B11 | 246±21 | 92 | 53 | 90 |
| B12 | 240±30 | 90 | 45 | 85 |
| B13 | 230±30 | 92 | 49 | 82 |

**Table 10 Effect of amount of DCM on the particle size, yield and floating of microspheres**

| Batch No. | Mean particle size (µm) | %Yield | % Floating | Incorporation Efficiency |
|---|---|---|---|---|
| C1 | 270±12 | 96% | 48% | 85% |
| C2 | 345±25 | 95% | 56% | 89% |
| C3 | 395±61 | 91% | 56% | 92% |
| C4 | 469±80 | 90% | 58% | 86% |

### Effect of Amount of Acrycoat S100

Amount of Acrycoat S100 did not affect the yield of microspheres significantly. However, the average particle size increased as the amount of acrycoat S100 increased. When the amount of acrycoat S100 was 1.5 gm in 25 ml organic phase it started to form aggregates. When it was 0.5 gm in 25 ml organic phase, it started to form irregular microspheres. Based on the results, subsequent experiments to investigate the effect of various processing parameters on the formation of microspheres used the following composition of the organic phase; Ethanol: IPA: DCM: Acrycoat S100 (6.66ml: 10ml: 8.33ml: 1 g). Results of these trials are shown in Table 5.11.

**Table 11 Effect of amount of Acrycoat S100 on the particle size, yield and floating of microspheres**

| Batch No. | Mean particle size (µm) | %Yield | % Floating | Incorporation Efficiency |
|---|---|---|---|---|
| C5 | 265±55 | 98% | 45% | 88% |
| C6 | 390±14 | 96% | 52% | 90% |
| C7 | 410±65 | 94% | 57% | 85% |

### Effect of Rotation speed

At higher speed, irregular microspheres were obtained probably because of increased incidence of collision of the dispersed phase and subsequent rupturing of microsphere. At lower speed sticking of the microsphere was noticed. The optimum rotation speed is 250 rpm with respect to morphology and yield of microspheres. Results of these trials are depicted in Table 12.

### Effect of Emulsifier concentration

Spherical microsphere was obtained at 1% conc. of PVA. At higher PVA concentration, particle size of the microspheres becomes smaller. This is because at higher concentration at emulsifier, droplet size of the emulsion decrease and thereby particle size of the microspheres also decreases. Results of these trials are shown in Table 13.

**Table 12 Effect of Rotation speed on the particle size, yield and floating of microspheres**

| Batch No. | Mean particle size (µm) | %Yield | % Floating | Incorporation Efficiency |
|---|---|---|---|---|
| C8 | 400±20 | 89% | 49% | 92% |
| C9 | 340±32 | 97% | 55% | 94% |
| C10 | 270±51 | 95% | 53% | 89% |
| C11 | 200±80 | 92% | 58% | 87% |

**Table 13 Effect of emulsifier concentration on the Particle size, Yield and Floating of microspheres**

| Batch No. | Mean particle size (µm) | %Yield | % Floating | Incorporation Efficiency |
|---|---|---|---|---|
| C12 | 370±20 | 89% | 56% | 83% |
| C13 | 350±50 | 91% | 52% | 88% |
| C14 | 210±75 | 93% | 57% | 90% |

### Micromeritic Properties of the Drug-Loaded Hollow Microspheres

Microspheres were prepared with optimized parameters and evaluated for the Micromeritic Properties like Angle of Repose, Compressibility Index, Tapped Density and True Density.

**Table 14 Micromeritic Properties of the Drug-Loaded Hollow Microspheres**

| Angle of Repose ϕ (degree) | Compressibility Index *I* (%) | Tapped Density (g/cm$^3$) | True Density (g/cm$^3$) |
|---|---|---|---|
| 23.73$^0$ | 13% | 0.229 | 0.797 |

Usually, the micro particulate drug delivery systems are formulated as single-unit dosage forms in the form of tablets or capsules. Such micro particulate systems should possess the required micromeritic properties. The flow property of the hollow microspheres was studied by calculating the angle of repose ϕ and compressibility index *I*. These data, along with the related parameters, are presented in Table 14 The values of ϕ is 23.73°, indicating reasonable flow potential for the particles. These results are further substantiated by the values of *I*, which is 13 %, suggesting good flow characteristics of the microspheres. The tapped density value of the floating microspheres was 0.229 g/cm3, while their true density was 0.797 g/ cm3. Obviously the density values of the floating microspheres (</1.000 g/cm3) were less than that of the gastric fluid (~/1.004 g/cm3), thereby, implying that these microcapsules will have the propensity to exhibit an excellent buoyancy effect in vivo. The better flow property indicates that the hollow microspheres produced are nonaggregated. Photomicrographs of Acrycoat S100 microspheres are shown in Fig. 2

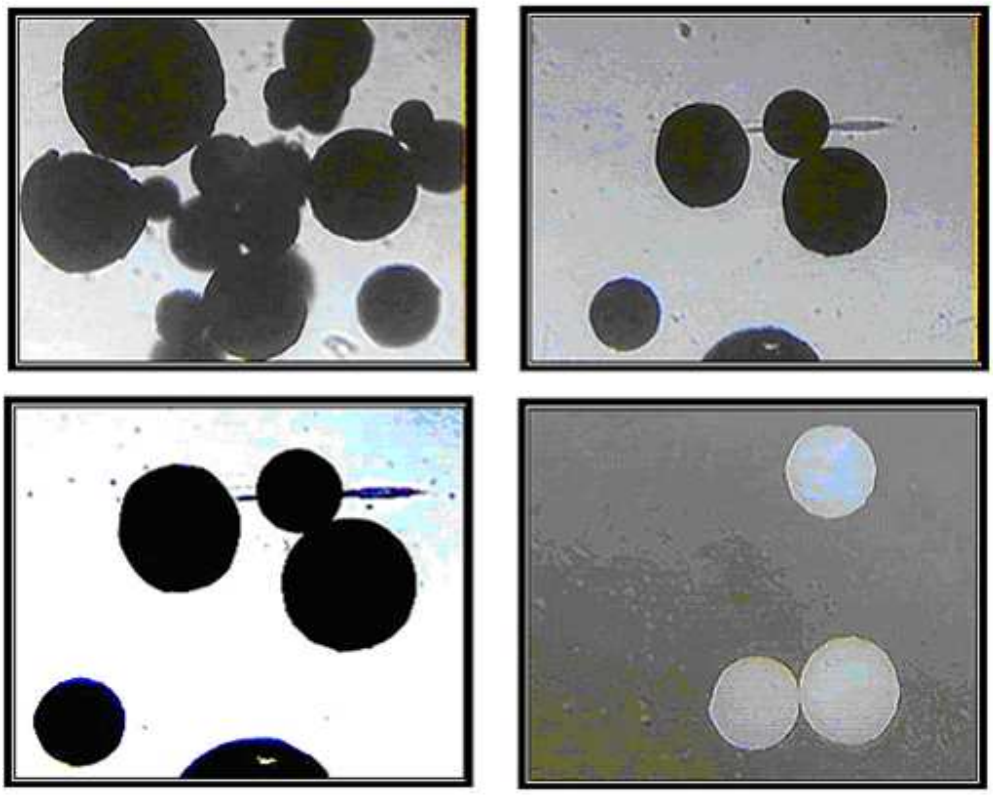


**Fig 2: Photomicrographs of Acrycoat S100 microspheres of Glipizide**

**FTIR spectra study**

From IR spectra of Glipizide, Acrycoat S100, and Microspheres it can be seen that there is no significant change in IR spectra of microspheres i.e., it is nearly same to

hat of plain compounds. IR Spectra is shown in Figure 3.

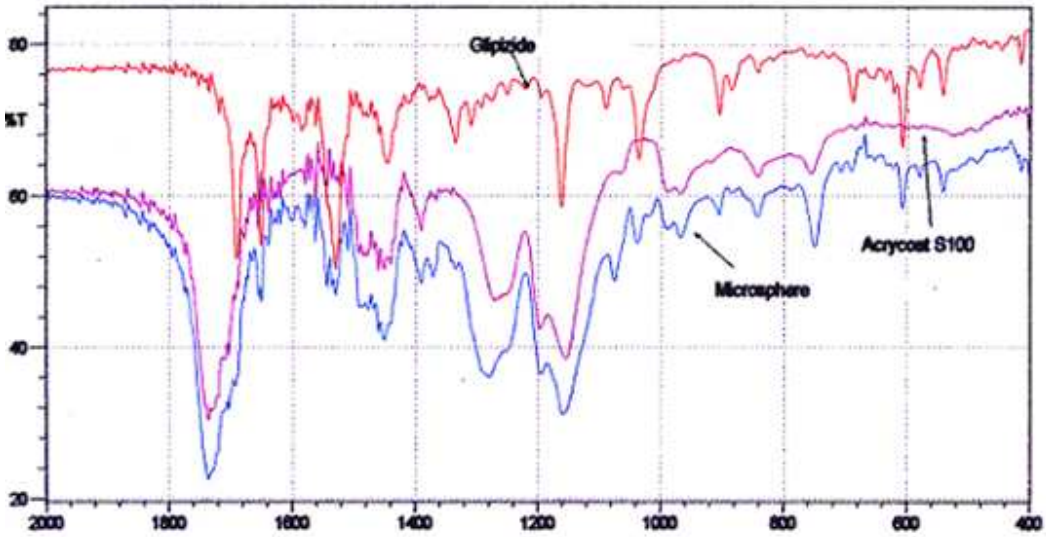



**Fig. 3: IR spectra of Glipizide, Acrycoat S100, and Microspere**

## CONCLUSION

The present study reports the development of drug-loaded floating microspheres of acrycoat S100 (acrylic resin) with an internal hollow structure by a solvent diffusion and evaporation method. The yield of microspheres depended on the diffusion rate of alcohol in the organic phase. The mixing ratio of components in the organic phase affected the size and the yield of Microspheres. Direct introduction of the organic phase into the aqueous phase though a glass tube also significantly improved the yield by avoiding the contact of organic phase with the surface of water. The microspheres produced exhibited good encapsulation efficiencies and micromeritic properties for formulation as single-unit dosage forms. The microspheres were having lower densities. Encapsulation efficiency of microspheres is around 90%. This is because of the low solubility of glipizide in aqueous solution

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