Effect of Sitagliptin on the Micellization of CetylTrimethylammonium Bromide

Deepak Sinha*

*Corresponding Author, Government Nagarjuna Post Graduate College of Science, Raipur (C.G.)-492010, India

Received: May 5, 2018

Accepted: June 5, 2018

ABSTRACT

Here we determine the specific conductivity of aqueous solution of sitagliptin, an anti-diabetic drug in the presence of cationic surfactant cetyl trimethylammonium bromide (CTAB) at different temperature range. It was interested to enhance the solubility of sitagliptin in the micellar solution. The critical micellar concentration (CMC), degree of ionization and thermodynamic parameters such as Gibb’s free energy, enthalpy and entropy were estimated by conductivity measurements. The results confirms that CTAB micelles can solubilizes sitagliptin significantly and increases its solubility in aqueous medium.

Keywords: Schedulingmicellization, sitagliptin, cetyltrimethylammonium bromide, solubility.

INTRODUCTION

Micellar solubilization is an area of investigation for improvement of poorly soluble compounds having pharmaceutical properties. Surfactants are the amiphilic organic compound having hydrophobic non-polar tail and hydrophilic polar head in a single molecule. In aqueous solution, molecules of surfactant clumps and form an aggregate called micelle. Solubilization of drugs by surfactant system has been reviewed and discussed by a number of researchers. The advantages of micellar solubilization of drugs for drug delivery purpose, solubility of poorly soluble drug, reducing toxicity, improving bioavailability and other side effects.

Sitagliptin is an oral dipeptidyl peptidase IV drug usually used in the treatment of type II diabetes mellitus. They increases the level of insulin and decrease the glycogen in pancreas with the help of alpha cells.

EXPERIMENTAL

Surfactant and chemicals are purchased from molychem laboratories, Mumbai and these are AR grade. Januvia (sitagliptin) drug tablets are purchased from authentic distributor. Micropipette (10-100µL)
was used for preparing various working solutions. All the glass wares used are sterilized and cleaned with double distilled water. Double distilled water was used in all solution preparations.

Conductivity measurements were performed with digital conductivity meter supplied by Systronic direct reading (type 306). The conductivity cell constant was calibrated with KCl (0.001 and 0.01M) solution in appropriate concentration range. The surfactant solution was progressively added with the help of micro pipette taken in a small beaker and the conductance was measured after thorough temperature equilibrium. The break point in the plot of specific conductivity versus the total surfactant concentration was taken as the CMC at the mole fraction.

RESULT AND DISCUSSION

The CMC value of CTAB is obtained at different temperatures using a digital direct reading conductivity meter. The variation of CMC value of Cetyltrimethyl ammonium bromide (CTAB) with the increasing temperature was found and analyzed for finding suitable temperature required for micellization.

The CMC value was measured by plotting a graph between equivalent conductivity Vs. $C^{1/2}$ at various temperature ranging from 25°C - 45°C. Fig. II shows the variation of CMC of CTAB with increasing temperatures.

<table>
<thead>
<tr>
<th>TEMPERATURE</th>
<th>CMC OF CTAB $\times 10^{-3}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>303 K</td>
<td>9</td>
</tr>
<tr>
<td>308 K</td>
<td>11</td>
</tr>
<tr>
<td>313 K</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 2: VARIATION OF CMC VALUE OF CTAB WITH INCREASING MOLAR CONCENTRATION OF SITAGLIPTIN AT DIFFERENT TEMPERATURES

<table>
<thead>
<tr>
<th>MOLAR CONC. OF SITAGLIPTIN</th>
<th>CMC at 303K</th>
<th>CMC at 308K</th>
<th>CMC at 313K</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2 \times 10^{-3}$</td>
<td>$8.2 \times 10^{-4}$</td>
<td>$9 \times 10^{-4}$</td>
<td>$10 \times 10^{-4}$</td>
</tr>
<tr>
<td>$4 \times 10^{-3}$</td>
<td>$7.4 \times 10^{-4}$</td>
<td>$8.3 \times 10^{-4}$</td>
<td>$9.0 \times 10^{-4}$</td>
</tr>
<tr>
<td>$6 \times 10^{-3}$</td>
<td>$7.35 \times 10^{-4}$</td>
<td>$7.9 \times 10^{-4}$</td>
<td>$8.7 \times 10^{-4}$</td>
</tr>
</tbody>
</table>

Fig 2: - Conductivity as the function of concentration of CTAB at different temperatures [A] at 303K [B] at 308K.
Fig 3: Variation of CMC value of CTAB with increasing molar concentration of sitagliptin at different temperatures.

The solubility of spironolactone was found to increase with increasing concentration of both the surfactants. Solubilization of drug in surfactant solution can be given by two descriptors such as molar solubilization ratio and micelle-partition coefficient.

From the value of CMC, thermodynamic parameters Gibb’s free energy, enthalpy and entropy were estimated as a function of temperature and concentration of drug. From the thermodynamic point of view, all the solubilization behavior of the studied system can be measured by the standard free energy of solubilization ($\Delta G^\circ_m$) given by the following equation –

$$\Delta G^\circ_m = -RT \ln \text{CMC}$$

CONCLUSION

An increase in the CMC value of SDS with the increase in temperature suggests that a high temperature retards micellar growth i.e. high temperature does not favors micellization process. Presence of spironolactone in aqueous solutions of SDS results in a decrease in CMC of these surfactants indicating a good solubility of spironolactone in such micellar system. By knowing the suitable values of these parameters, and maintaining these value throughout the experiment, the solubility of poorly soluble drugs in solvent can be enhanced.

REFERENCES