Conduct metric Studies on the Thermal Effects on Micellization Behavior of CTAB in Aqueous Medium

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Abstract: An important property of CTAB is its ability to form micellar aggregate which can be used as a medium to dissolve various sparingly soluble substances thereby acting as a solvent for the manufacture of paints and emulsions, in leather industries and also as drugs carrier for various sparingly soluble drugs thereby increasing their bioavailability, minimize drug degradation and loss of drugs to prevent harmful side effects. The present work mainly involves the "Conductometric studies on the thermal effects on micellization behavior of CTAB in aqueous medium."This work is mainly useful in determining the suitable temperature for the availability of CTAB as a solvent and carrier for various sparingly soluble substances in water which can be used in different industries.

Keywords: *CMC, Micelle, Surfactant, CTAB*

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INTRODUCTION

The study of micelles mainly starts with the knowledge of surfactants. The term surfactant is derived from the word surface active agents. They are organic compounds which are amphiphillic in nature i.e. they contain both hydrophilic and hydrophobic groups thus they are soluble in organic solvents as well as in water [M.Vlachyet 2008].Surfactants are known to form micelles which have attracted much attention from scientists. When the surfactant molecule is added to water, the non- polar part (tails) of surfactant clump into the center of a ball like structure called micelle. The polar part (head) however presents itself for interaction with water on the outside of micelle. [D.P.Tieleman 2000].A micelle is an aggregate of molecules dispersed in a liquid. A typical micelle forms an aggregate with the head region in contact with the surrounding, sequestering the tail region in the micelle centre. This type of micelle is known as normal phase micelle.[J.Shanthalakshmi 2001].These micelles have different shapes like spherical, rod like ellipsoid and cylindrical depending upon the conditions and composition of the system. The concentration of a surfactant molecule at which micelles appear is called critical micelle concentration (CMC).The occurrence of CMC results from a delicate balance of intermolecular forces. Micelles have an anisotropic distribution of water in their structure. The concentration of water decreases from surface to the core i.e. completely hydrophobic atthe core. These aggregates show an interfacial region separating the polar aqueous phase from hydrocarbon like interior. As a consequence ,micellar solution consists of special medium in which hydrophobic, amphiphillic or ionic compounds may be solubilized. Poor aqueous solubility is a major obstacle in the development of therapeutic agents. Some of the approaches to enhance poor solubility of drugs include the use of co-solvents [M.A.Etman2001 and S.H.Yalkowskyet1999].Selection of salt form[A.B.Neilsen and P.M.Bhatt2005].Preparation of solid dispersions **[**Neelam Seedhar and Mamta Kanojia. 2008].Micellar solubilisation is a widely used alternative for the dissolution of poorly soluble drugs.[C.O.Rangelet2005].Depending upon the hydrophobicity the sparingly soluble dyes, drugs and other useful substances can be solubilized in the inner core of micelle, on the surface of micelle or at an intermediate location in the palisade layer. Thus by knowing the structure and properties of micelles the solubility of these substances can be enhanced.

MATERIALS AND METHODS

Surfactant CTAB is of AR and Merck grade. A study on the CMC of CTAB was made at different temperatures. The temperatures were maintained by using a digital thermostatic water bath.

Chemicals used:

Cetyl tri methyl ammonium bromide (CTAB) CAS No. – 57-09-0

Molecular formula:$C_{19}H_{42}BrN$

Apparatus:

1) Conductivity meter: (Digital direct reading systronics type) used for conductivity measurement. This conductivity meter was calibrated with KCl solution of appropriate concentration range.

2)Thermostat: For maintaining the temperature settings constant throughout the experiment a thermostat set at 30^0C to 45^0C with automatic temperature control ± 0.1^0C at the required temperature is used.

Preparation of solutions:

A stock solution of CTAB is prepared by direct weighing and dissolving in DDW. The concentration of the surfactant was progressively increased by successive additions of aliquots of stock solution of concentration several times larger than the CMC. Then these solutions were used for further investigation.

Effect of temperature:

The conductivity of these solutions was measured by using direct digital conductivity meter of known cell constant at different temperatures. Desired temperature is kept constant with the help of digital thermostatic water bath. The CMC value was measured by plotting a graph between equivalent conductivity Vs $C^{1/2}$at various temperatures ranging from 30^0C to 45^0C. The break point obtained in the graph corresponding to the molar concentration of CTAB was taken as CMC of CTAB at that temperature which is expressed in Moles / lit. Fig. I shows the variation of CMC of CTAB with increasing temperature.

FIGURES AND TABLES

TABLE - I

Variation of CMC of CTAB with increasing temperature

S.No.	Temperature in Kelvin	CMC Value x 10 4 in Moles/lit
1	303	9
2	308	11
3	313	14
4	318	16

Variation of CMC value of CTAB with increasing temperature

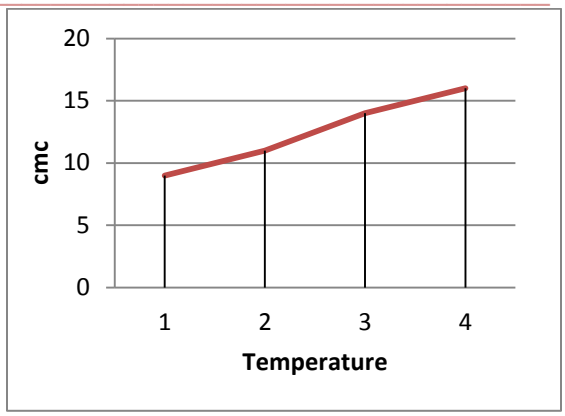

Fig. 1

RESULTS AND DISCUSSION

A systematic study on the critical micelle concentration of CTAB was made. Effect of temperature on the CMC value of CTAB in aqueous medium was found. Results obtained are summarized in figure A. It was observed that the CMC value of CTAB increases with the increase in temperature. The increase in the CMC value with temperature indicates that the increase in temperature does not favour the formation of micelle. Thus the solubilisation of sparingly soluble drugs and dyes can be made at a lower temperature suitable for the formation of micellar aggregate. The micelle dissociates into monomers at a higher temperature which does not favor the solubilisation process.

REFERENCES

[1] M.Vlachy, M.Dreshler and T.M.Vesbarvatz,Role of surfactant head group on counterion specificity in micelles to vesicle transition through salt addition,J.colloid interface Sci.319,542,2008.

[2] Y.Moroi, Micelle: theoretical and applied aspect, Plenum press, Newyork, 1992.

[3] S.P.Moulik,Micelles: self-organized surfactant assemblies current Sci.,71,5,1996.

[4] D.P.Tieleman,VanderSpoel,H.J.C.Berendsen,Molecular dynamics simulations of dodecyl phosphocholine micelle at three different aggregate sizes: Micellar structure and chain relaxation,J.Phys.Chem.B**104**,6380-6388,2000.

[5] M.A.Etman,R.O.Salama,M.A.ShamsedeenandA.Elkamel.Solubilisationofetodolacfor parenteral administration. Indian j. Pharm. Sci.**63**, 459-467, 2001.

[6] S.H.Yalkowsky. Combined effect of co-solvent and cyclodextrin on solubilization of non- polar drugs. J.Pharm.Sci**.88**, 967-969, 1999.

[7] P.M.Bhatt, N.V.Ravindra, R.Banerjee, and G.R.Desiraju, Saccharin as a salt former. Enhanced solubilities of saccharinates of active pharmaceutical ingredients. Chem.Commun.**8**, 1073-1075, 2005.

[8] NeelamSeedhar and Mamtakanojia, Micellarsolubilisation of some poorly soluble Anti-diabetic drugs. AAPSP PharmSciTech**, 9,** 431, 2008.

[9] K. G. H. Desai and H.J.Park. Solubility studies of Valdecoxib in the presence of carriers, co-solvents and surfactants.Drug Dev. Res**.62**, 41-48, 2004.

[10] C.O.Rangel– Yagui, H.W.L.Hsu, A.PessoaJr, and L.C.Tavares.Micellarsolubilisation of drugs. J.Pharm.Pharmaceutical Sci.**8,** 147-163, 2005.

[11] NeelamSeedhar and MamtaKanojia, Micellarsolubilisation of some poorly soluble anti-diabetic drugs. AAPS PharmSciTech**, 9**,431-436, 2008.

[12] Ajit. S.Narang, David Delmarre, DanchenGao, Stable drug encapsulation in micelles and microemulsions. IntJ.Pharm. **345**, 9-25, 2007.

[13] Carlota O. Rangel-Yagui, Helen Wei Ling Hsu,Adalberto Pessoa-Jr,Leoberto Costa Tavares, Micellarsolubilisation of Ibuprofen-Influence of surfactant head groups on the extent of solubilisation. Brazilian journal of pharmaceutical sciences, Vol.**41**, 237-246, 2005.

[14] M.F.Francis,M.Cristea,F.M.Winnik, J.C.Leroux, Polymeric micelles for oral drug delivery. Proceed.Intern.Symp.Control.Rel.Bioacta.Mater.**30**, 68-69, 2003.

[15] Mohamed Benrraou, Barney L. Bales, Raoul Zana. Effect of the nature of counter ions on the properties of anionic surfactants. J.Phys.Chem.B**107**, 13432-13440, 2003.