Determination of 2-Mercaptoethanol by Potentiometric Titration with Mercury (II) Chloride

Ali Rasool Mahmood Albakaa
Department of Pharmaceutical Chemistry,
College of Pharmacy, University of Al-Mustansiriyah, Baghdad, Iraq

Abstract

A new, direct, rapid, simple, sensitive and accurate method for the determination of 2-Mercaptoethanol (Quick facts) or Mercury(II); The method is based on the using mercury (II) chloride solution as titrant (or reverse) in potentiometric titration depending on the first and second derivative differential procedure was used for all titrations; The method is suitable for the assay of 2-ME in micro amounts at a wide range of mass (15626.6-7.8133 µg) in 80 mL; The equivalence point is marked by a sharp peak in all instances and molar ratio of (Hg2+: 2-ME) at inflection point (1:2). Accurate and precise results were obtained with an average error % of (0.1333-0.5667%) and a Relative Standard Deviation of (0.70499-0.1957%) respectively.

Introduction

2-Mercaptoethanol; 2-ME is a clear, colorless liquid with disagreeable odor it is miscible in water and nearly all common organic solvents and Specific gravity 1.115, the structure of 2-ME shown in Figure 1. 2-ME is prepared by reaction of hydrogen sulfide gas with ethylene oxide, it is primarily used in clinical laboratories as a reducing agent, the clinical and medical use of 2-ME has increased considerably, whereby it is also used for living-cell transformation investigations, cell mediated cytotoxicity studies and studying the enzyme activity in cellular systems; In solution, especially at alkaline pH, 2-ME is readily oxidized in air to a disulfide; Because of this property; It is used as a chain transfer agent in the manufacture of PVC and as intermediate for the synthesis of PVC heat stabilizers, it is used as a building block to produce corp. protection products, pharmaceuticals, fibers, textiles, dyes, and dispersants, and used as a component of corrosion inhibitors and ore floatation agent. In biochemistry, due to its strong reducing properties, it is studied in the activity of immune system or denatures the proteins, 2-ME denatures the proteins by reducing disulfide linkages leading to tautomerization and breaking up quaternary protein structure and has been studied as anti-cancer agent by acting as alkylation agent to damage the cancer cell DNA. An excess of 2-ME (generally used at 0.01M) will maintain the protein thiol groups in their reduced state; Researchers have seen art factual bands in SDS-PAGE systems, appearing in the range of 54 to 68 kDa, particularly in 2-dimensional electrophoresis systems when sensitive staining techniques are used to detect proteins, such as gold or silver staining [1-4]. Determination of 2-Mercaptoethanol by Potentiometric Titration with Mercury (II) Chloride Ali Rasool Mahmood Albakaa* Department of Pharmaceutical Chemistry, College of Pharmacy, University of Al-Mustansiriyah, Baghdad, Iraq Abstract A new, direct, rapid, simple, sensitive and accurate method for the determination of 2-Mercaptoethanol (Quick facts) or Mercury(II); The method is based on the using mercury (II) chloride solution as titrant (or reverse) in potentiometric titration depending on the first and second derivative differential procedure was used for all titrations; The method is suitable for the assay of 2-ME in micro amounts at a wide range of mass (15626.6-7.8133 µg) in 80 mL; The equivalence point is marked by a sharp peak in all instances and molar ratio of (Hg2+: 2-ME) at inflection point (1:2). Accurate and precise results were obtained with an average error % of (0.1333-0.5667%) and a Relative Standard Deviation of (0.70499-0.1957%) respectively. Although these have appeared when 2-ME is used, they have been attributed to the action of

2-ME on some component in the system. These bands may be eliminated by removing the 2-ME from the protein sample during equilibration and replacing it by iodoacetamide, which reportedly improves recovery and detection of proteins [3,4]. Complexes of mercury species with 2-mercaptoethanol are widely used in reversed-phase separation because of its chemical structure, until now the reagent was not solely used for extraction of mercury species in any solid sample [5]. 2-ME can be determined by means of two basic analytical procedures:- a) Identification of the –OH group. b) Identification of the –SH group, either by oxidation to disulfide or by reaction with metal ions and formation of mercaptides. Determination of SH group is generally considered to be the most suitable procedure owing to its wide application ability and relatively better accuracy and simplicity. In the past, analysis of 2-ME has been done by redox titration (about 8 g), this procedure is lengthy (more than 20 min.); A GLC procedure was developed for the determination of 2-ME [6]. HPLC with fluorescence detection developed for the determination of 2-ME [7]. Determination of 2-ME in water samples after extraction by using homogeneous liquid-liquid micro-extraction and GC with FID [8]. 2-ME was titrated coulometrically with the generated iodine [9] and A carbon-paste electrode modified with iron (II) phthalocyanine (FePc) was used as a sensitive potentiometric sensor for determination of 2-ME in aqueous solutions [10]. HOE electrode has been further coated with Nafion or Tosflex ion-exchange membranes and used in the determination of concentration of 2-ME by direct potentiometry [11]. Figure 1: Chemical structure of 2-Mercaptoethanol. Page 2 of 4 Citation: Albakaa ARM (2016) Determination of 2-Mercaptoethanol by Potentiometric Titration with Mercury (II) Chloride. Chem Sci J 7: 138. doi: 10.4172/2150-3494.1000138 Volume 7 • Issue 3 • 1000138 Chem Sci J ISSN: 2150-3494 CSJ, an open access journal The complex tetraaminophthalocyanato-cobalt (II), electro-polymerized onto an electrode surface, serves as an excellent sensor for the quantitative estimation of 2-ME over a wide pH range [12]. Most of these methods for the quantitative estimation of 2-ME are time consuming, tedious, and expensive; require special devices, and not sensitive. While 2-ME has been used to estimate some metals ions, such as spectrophotometric determination of Pd(II) with 2-ME, a yellow colored complex formed at ratio (1:2) in a (potassium hydrogen phthalate-hydrochloric acid) buffer pH 4 [13]. Indirect determination of Cu2+ using 2-ME as masking reagent [14], 2-ME used for the spectrophotometric determination of Se(II), the water soluble complex shows maximum absorption at (380 nm), and this was used as the basis for the spectrophotometric determination of Se [15]. Complexometric determination of Cd(II) using 2-ME as masking reagent [16]. Indirect complexometric determination of Bi(III) using 2-mercaptoethanol as masking agent [17] and Complexometric determination of indium(III) using 2-ME as masking agent [18]. The Potentiometric response using ordinary pyrolytic graphite electrodes (OPG) modified with cobalt phthalocyanine (Co-Pc) was used for determination of 2-ME thiols group in aqueous solutions at pH values between (11- 4) [19] these chemical methods for determinate of 2-ME (or used) are difficult, consume many chemicals, need calibration, extraction before determination and required special devices. The mercaptane containing sample is titrated in neutral aqueous or acetone medium with mercury (II) ion as fallow [20]: $Hg2+ + 2RSH \rightarrow (RS)2\ Hg + 2H+$ In this article, a new potentiometric titration method to determine 2-ME with mercury (II) chloride (or reverse) is described, the method presents good advantages such as short retention time and economy, and the method, being reasonably selective and accurate, it is simple and rapid as it does at room temperature.