CHAPTER I

INTRODUCTION

1.1. Statement of the problem

Silver is one of heavy metal used in many industries. It is toxic to all living cell, deposited deeper skin layers and around nerves and may cause permanent skin damage. It can stick to fish gills and can be a cause of death [1]. Therefore, the silver determination methods have been developed for many years ago.

Furthermore, in this work, the determination of silver nanoparticles in silver ion form is interesting because of its property such as inhibition of bacteria which causes decay, itching, disease, smell and wound infection. Nanoparticle of silver can pass through cell wall of bacteria to bind with sulfur of sulfhydryl group of protease enzyme and with DNA lead to cell damage and death of bacteria cell [2]. However, researchers have serious concerns about the toxicity of silver nanoparticles to aquatic microorganism, plants and animals. It has been shown in vitro studies that silver nanoparticles can damage liver cell, stem cell and brain cell of mammal [3] .

Several techniques for determination of silver nanoparticles have been reported such as inductively coupled plasma atomic emission spectrometry (ICP-AES) [4], inductively coupled plasma-mass spectrometry (ICP-MS) [5, 6] and graphite furnace atomic absorption spectrometry (GFAAS) [7]. The determination of silver ions by using voltammetry [8], spectrophotometry [9], electrothermal atomic absorption spectrometry (ETAAS) [10, 11], ICP-AES [12] and ICP-MS [13, 14] has been reported. These techniques mentioned above are efficient for measuring silver nanoparticles and silver ions, however, they cannot use for speciation analysis and they are time-consuming because of sample preparation step, high operation cost, expensive instrument and require sophisticated equipment An ion-selective-electrode (ISE) technique is another method used for determination of silver nanoparticles [15, 16] and silver ions [17-20]. However, some drawbacks of this technique are matrix interference [21, 22] and electrical interference [23] because ISE is the technique measuring the potential generated across a membrane. Therefore, optical sensors technology has been interesting.

Bulk optode sensors have been widely used in analytical chemistry to determine heavy metal ions. We are interested in the bulk optode technique because of its advantages such as simple preparation, high selectivity, high sensitivity, fast response time, low cost apparatus, reversibility, repeatability and this technique can be detected by naked-eye. In the previous research, the optical sensors as optode membranes have been used for determination of various cations. They also have been developed for silver ion determination by varying the components of the optode membrane including silver-selective ionophore.

The objective of this work are to fabricate the optode membranes containing 25,27-di(benzothiazolyl)-26,28-dihydroxycalix[4]arene (CU1) as a silver-selective ionophore for silver ion determination because calix[4]arene derivative containing S and N atoms employed building blocks for silver ions. Moreover Wittaya Ngeontae *et al.* [16] reported high selectivity coefficient of silver ion over Na^+, K^+, Ca^{2+}, Mg^{2+}, Hg^{2+}, Cd^{2+}, Pb^{2+}, Zn^{2+}, Cu^{2+} and Ni^{2+}

The optode membrane incorporating of CU1, 9-(diethylamino)-5-(octadeca noylimino)-5H-benzo[a]phenoxazine (chromoionophore I) as a chromoionophore and potassium tetrakis(4-chlorophenyl)borate (KT*p*ClPB) as a lipophilic anionic additive plasticized in PVC membrane using bis(2-ethylhexyl) sebacate (DOS) as plasticizer was prepared. The fabricated optode membranes were used as a sensing device for determination of silver ion detected by absorption spectrophotometry in batch system. We expected the proposed optode membrane was successfully applied to determine silver ion in commercial products.

1.2. Research objectives

The objectives of this work are to fabricate the optode membranes containing CU1 as ionophore for silver ion determination by UV-Vis spectrophotometry, to study type and ratio of compositions of optode membrane and to optimize the conditions for determination of silver ion in commercial products.

1.3. Scope and benefit of the research

The optimum conditions for silver ion determination were investigated. The parameters affected the response behavior e.g. composition of the optode membrane, effect of pH, response time, selectivity and working range were studied. Lifetime, repeatability and repeatability were also studied. The fabricated optode membranes were applied to determine silver ion in commercial products with spiked method.

In this work, we expected to determine silver ions at low concentration using silver-selective optode membrane.