CHAPTER I

INTRODUCTION

1.1 Statement of the problem

Environmental pollutions concerned with heavy metal ion are still serious and its toxicity is mostly harmful for life processes. For example copper can be toxic to biological systems when it exceed the levels of cellular needs and it is also able to displace other metal ions which act as cofactors in enzyme-catalyzed reactions [1]. Lead is well known as a heavy metal which is harmful to human health and environment even at a low level [2, 3]. Aluminum is the third common element existing in rock and soil. Nowadays, it is released in several forms from many manufacturing processes. Aluminum can also contribute to several neurodegenerative disorders such as Alzheimer's disease [4, 5]. Moreover, iron plays an important role at cellular level as both its deficiency and excess can induce a variety of diseases [6, 7]. Therefore, the determination in terms of qualitative and quantitative analysis should be recognized for future management.

Nowadays, the monitoring methods such as spectrophotometric method and electrochemical method are the standard method for determining of metal ions but it is still expensive, time consuming and expert operator needed. Onsite methods for rapidly detecting of metal ions contamination are widely developed. Color detection is the most famous method because it is easy to operate, fast and low cost. Most of colorimetric reagents are obtained from synthetic process which causes environmental pollutions. Moreover, their high prices have to meditate. Though, the previous researchers have developed the new chemicals in terms of the selectivity or detection limit for metal ion determination [8-10], simultaneous detection by naked-eye method has not been widely reported, especially for both qualitative and

quantitative determinations. Up to now, only few metal ions have been commonly identified. However, they were determined individually [11], or the mathematical system was required to eliminate interfering effect [12], resulting in the complicated operation.

Modification of colorimetric reagent on suitable solid support is one way to accumulate some metal ions from aqueous solution on its surface and would be better if the complex will response in the color change. Thus, this material can also be solid sensor for metal ion detection.

Many researchers reported that plant pigments such as anthocyanin and betanin can interact with various metal ions responding in visible observation. Even chlorophyll, it is widely known that its structure consists of Mg(II) inside. Cyanidin is the major type of anthocyanin, whose structure contained *ortho*-dihydroxyl group in the B-ring as shown in Figure 1.1. This structure contributes coordination with various metal ions and then the bathochromic shift in visible region is appeared [13-15].

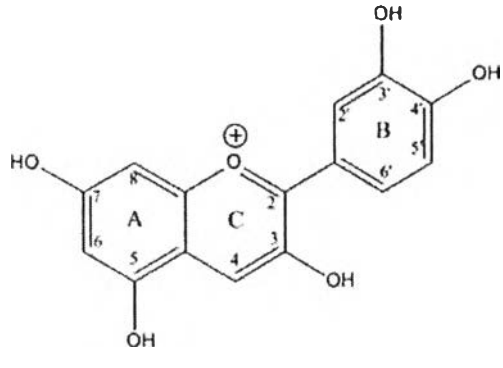

Figure 1.1 Cyanidin structure

However, there are no reports about applying natural product as chemosensor on any solid sorbents. Therefore, in this study we focused on selection of a colorimetric reagent from natural products such as cyanidin and modification of this reagent on suitable solid sorbent for determination of target metal ions by naked-eye detection.

1.2 Objectives and scope of the thesis

This research aims to develop the easy method for determination of some metal ions (Cu(II), Pb(II), Fe(III) and Al(III)) in aqueous sample using natural products as chelating agent. Cyanidin is one kind of anthocyanin and its structure containing *ortho*-dihydroxyl group which can coordinate with several metal ions as described above. In addition, it can be found in several vegetables growing all the year. Red cabbage was the best choice because it is the Thailand local plant, very cheap and abundant in cyanidin content. The experimental of metal ion detection was first investigated in term of using cyanidin solution as regent. Then, cyanidin solution was modified on suitable solid sorbent to be solid sensor for simultaneous determination of these four metal ions. Optimum conditions such as effect of pH, interfering ion effect, reaction time including the stability of this reagent and modified solid sorbent were investigated. The proposed method of this study in term of both qualitative and quantitative determination of metal ions was investigated by simultaneous along with naked-eye detection. The method validations were evaluated by comparing with inductively couple plasma optical emission spectrometry (ICP-OES) which is the standard method for trace elements determination.

1.3 The benefits of this research

According to this research propose to develop an easy method for simultaneous detection of metal ions in aqueous sample. There are many advantages of simultaneous along with naked-eye detection for example it is selective to a cluster of metal ions due to the unique molecular system with similar binding site, the operation is inexpensive, rapid and also real time on-sight detection. Moreover, it does not require an intricate mathematical system. In addition, this research can be applied for determination of metal ions in water sample at low level with simplicity, rapidity, low cost, no sample preparation requirement, and environmental friendly detection because of using small volume of all reagents. Moreover, the colorimetric reagent used is also very cheap because cyanidin is a common natural product and easily extracted from any plants. Modification of solid sorbent by cyanidin as newly solid sensor also shows effective determination of Cu(II), Pb(II), Fe(III) and Al(III) in real water samples. The solid surface was improved to achieve the good selectivity, mechanical stability and high reproducibility in sorption characteristics.