CHARPTER I

INTRODUCTION

Rationale for the study

Natural rubber (NR) latex is a milky fluid obtained from the *Hevea brasiliensis* tree, which is a major agricultural product of Thailand. NR latex composed of *cis*-1,4-polyisoprene is widely used for manufacture of tires, gloves, condom, etc. It is well known that NR latex contains proteins recognized as allergenic proteins which small amount of these proteins have risen to problem of latex allergy [1]. Proteins in NR latex and some rubber products may cause an increasing in the incidence of sensitization, adversely allergic reactions, and even death through anaphylactic shock. In addition, proteins have an effect on the stability, quality, and durability of some rubber products, especially in latex gloves because they contact with the skin more than other rubber products. Therefore, proteins determination before rubber production is very important. Currently, there are many techniques that can be effectively used for determining protein such as a standard test method for the analysis of aqueous extractable protein in NR and its products using the modified Lowry method (ASTM D5712-05) [2,3] and a standard test method for analysis of the total nitrogen in NR using Kjeldahl method (ASTM D 3533-90) [4]. However, these two standard test methods require analysis time, analysis skill, expensive instrument and large amount of chemical substances. Kjeldahl method is relatively harmful because this method uses concentrated acid such as sulfuric acid in combination with high temperature (~400°C) to decompose rubber particles in NR. Moveover, titration in the final step can cause error from visual observation. From these reasons, Kjeldahl method is not suitable for routine analysis. The modified Lowry method is based on three steps for protein analysis. The first step is protein extraction from NR and its products followed by protein precipitation and purification. Finally, protein is determined by the spectrophotometry. Hence, the modified Lowry method is selected in this research because the color forming is much more sensitive than the Biuret method and other colorimetric methods [5]. For spectrophotometry, standard protein solutions prepared to set up the calibration curve must perform under the same procedures as sample

pretreatment of the standard test method (ASTM D5712-05) which is complicated. Therefore, a new technique called artificial neural networks-digital image-based colorimetry will be used instead of spectrophotometry in this work.

The principle of digital image-based colorimetry (DIC) is based on measurement of the RGB value (Red, Green, and Blue) of different color intensities. The value provided to the user ranges from 0 to 255 for each color giving more than 16 million different colors [6]. This technique can be interpreted as a colorimetry by reflecting light. That is, a method where the light, reaching each pixel in an image sensor (charge-coupled device, CCD and complementary metal oxide semiconductor, CMOS), is the light reflected by objects. This passes through three different filters (RGB filters), then they are read by color-analysis software. Thus, this technique is highly suitable for colorimetric reaction. For the selection of an electronic sensor in a camera [7], the CMOS image sensor is employed in this research because CMOS image sensor is inexpensive, lower power dissipation, and provides possibility of making a portable digital image-based colorimeter. Recently, a novel technique that can improve the efficiency of DIC is artificial neural networks (ANNs) [8]. ANNs are the computerized analog of a biological neural system and they are the important class of pattern recognizer which are useful for chemometric applications. The constructed architecture of the ANNs model will develop relationships between the input and output data when training proceeds. The way of training the ANNs model simulates how biological neural connections are established and rectified perpetually. After appropriate training process, the nonlinear neural network can afford a best fit "guess" as a result. Hence, the ANNs are often used to represent or process nonlinear data [8,9]. The combination of ANNs method will be an alternative method to analyze proteins in NR latex. Therefore, the main purpose of this research is to study the possibility of CMOS webcam camera for the signal recording and the application of ANNs combined with DIC as a detector for the determination of protein in NR latex and latex gloves after color forming by the modified Lowry method without the calibration curve construction.

Research objectives

To study the possibility of CMOS webcam camera for signal recording and application of artificial neural networks combined with digital image-based colorimetry (DIC-ANNs) as a detector for the determination of aqueous extractable protein in NR latex and medical latex gloves.

Scope of the research

1. Construct a DIC lightbox for capturing the protein image.
2. Design and test the written software for an image processing.
3. Determine the amount of the protein in NR latex and medical latex gloves using the developed detector.

Usefulness of the research

1. ANNs-DIC detector enhances rapidity for the determination of the protein in NR latex and medical latex gloves without calibration curve construction.
2. Users can use the developed procedure to assess the quality of NR latex and medical latex gloves.