Characterisation of poly(vinyl alcohol) coating mixed with anthocyanin dye extracted from roselle flower with different nitrate salt

S.V. Lee
Centre for Ionics University of Malaya, Physics Department, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia

N.A. Halim
Centre for Defence Foundation Studies, National Defence University of Malaysia, Kuala Lumpur, Malaysia, and

A.K. Arof and Z.H.Z. Abidin
Centre for Ionics University of Malaya, Physics Department, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia

Abstract

Purpose – The purpose of this paper is to develop a new water-based coating system composed of poly(vinyl alcohol) and anthocyanin colourant extracted from Hibiscus sabdariffa L. and to characterise the system.

Design/methodology/approach – Anthocyanin from Hibiscus sabdariffa L. (roselle) calyxes was extracted by using distilled water and filtered to remove insoluble particle. Salts introduced into the extract were 5wt percent calcium nitrate, 5wt percent magnesium nitrate, and 5wt percent zinc nitrate. The solution was mixed with poly(vinyl alcohol) in ratio of 3:1. The mixtures were coated on glass substrate and allowed to cure for approximately one day. Colour of the extract systems was determined by CIELab colourimetry. FTIR spectroscopy was conducted on the samples to identify their functional groups and changes upon addition of salt. Thermal stability was assessed by thermogravimetric analysis (TGA). Differential scanning calorimetry (DSC) was employed to measure the glass transition temperature Tg of the samples. XRD was employed to determine the amorphous properties of the coating samples.

Findings – From FTIR spectroscopy, shifting in the OH stretching and CH2 bending bands was attributed to hydrogen bonds formation between PVA and nitrate salt. Shifting in the main decomposition step in samples with addition of nitrate salts in TGA was due to interaction of PVA and nitrate. Increase in glass transition temperature of samples with salts was attributed to the formation of hydrogen bonding. From XRD study, increase in the amorphous properties was due to the incorporation of nitrate salts into PVA coating.

Research limitations/implications – Limitation of implementating poly(vinyl alcohol) as coating is caused by its weak water resistance and hydrophilic properties. This study could bring about research towards incorporation of different natural colourant with different binder materials to form coatings which are environmental-friendly and low cost.

Practical implications – Mixture of PVA and anthocyanin colourant from roselle for use as coating has been developed. The coating can find usage in various applications such as coloured coating for furniture and wooden materials for decorative purposes, biodegradable design materials for interior purposes. It can be practically applied on a variety of substrates such as glass and wood.

Originality/value – Development of water-based coating from PVA binder with anthocyanin colourant is introduced in this study.

Keywords Roselle, Anthocyanin, Poly(vinyl alcohol), CIELab, FTIR, TGA, DSC, XRD, Dyes, Plants, Coating processes

Paper type Research paper

Introduction

Anthocyanin is a water soluble pigment that accounts for a variety of colours found primarily in flowers and fruits of higher plants, ranging from red, purple to blue. It has gained much attention for the past few decades and many researches were conducted on these properties. In food industry, it has exhibited a promising function as natural dye to replace artificial food colourant (Bridle and Timberlake, 1997). Its antioxidant and antiradical properties also gained interest in medical applications (Tsai et al., 2002). Roselle (Hibiscus sabdariffa L.), which belongs to the family Malvaceae, is a tropical plant commonly found in Asia and tropical Africa. Its calyxes, bright red in colour, are rich in anthocyanins. Du and Francis (1973) has reported two major anthocyanins: delphinidin-3-sambubioside and cyanidin-3-sambubioside, and two minor anthocyanins: delphinidin-3-glucoside and

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