UNIVERSITI TEKNOLOGI MARA

STABILITIES AND ENCAPSULATION OF *CATTLEYA BOWRINGIANA* ANTHOCYANIN EXTRACTS IN CALCIUM ALGINATE BEADS

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Thesis submitted fulfillment of the requirements
For the degree of
Master of Science

Faculty of Applied Sciences

October 2009

Author's Declaration

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Date 25 NOV 2009

ABSTRACT

Food colourants from natural resources are considerable in demand. They can serve as alternatives to synthetic dye as ingredients in food, cosmetic and pharmaceutical products. Nowadays, interests in anthocyanin-rich foods and extracts have intensified due to their health benefits. However, stabilities of anthocyanins are affected by pH, temperature, light, concentration and also their structures. This limits their commercial applications. Five different colour, namely red, violet, blue, green and yellow have been generated from the orchid flower of *Cattleya bowringiana*. The aims of this project were to study the effects of temperature and light on the stabilities of the five coloured *Cattleya bowringiana* anthocyanin extracts (CBAE) in solution and also to investigate the effect of alginate matrix on the stabilities of these coloured CBAE extracts by encapsulating these five extracts separately in calcium alginate beads (CAB) and chitosan coated calcium alginate beads (CCAB). Four types of beads were successfully prepared; macro-CAB, macro-CCAB, micro-CAB and micro-CCAB. The sizes of blank macro and micro-CAB were larger than macro-CCAB and micro-CCAB. The sizes of coloured CAB and coloured CCAB were smaller than the corresponding blank beads indicating possible interaction of CBAE with the alginate matrix. The stabilities of these five coloured CBAE in solution and in CAB were studied using UV/Vis spectrophotometer and chromameter. In this study, red CBAE in solution was found to be the most stable and red and violet CAB were relatively more stable than blue, green and yellow CAB under all conditions studied. The decreasing order of stability of CBAE was red > violet> yellow>green≥ blue while the decreasing order of stability of the CAB was red ≥ violet> yellow>green≥ blue ($p \leq 0.05$). All coloured CBAE in solution and coloured CAB were stable at 4°C. The degradation of anthocyanins for all coloured CBAE followed first order kinetics at 80 and 100°C except violet CBAE and second order kinetics at 4 to 45°C for all coloured CBAE except red CBAE. Green CBAE was highly loaded into macro-CAB (89%) and micro-CAB (93%) while the red and violet CBAE were relatively less loaded into CAB after 24 hours incubation. CBAE were found to release faster from micro-CAB than macro-CAB and CBAE were found to release slower from the chitosan coated beads than from the uncoated beads. The coloured CAB were more stable than the respective coloured CBAE in solutions. Results showed that increase in temperature decreased the stability of CBAE in solution to a greater extent than those in CAB. Blue and green CBAE in solution and in CAB were found to be stable on exposure to light (600 lux) at 27°C while red CBAE showed 73.2 % lost of colour on exposure to light. However, the red and violet CAB demonstrated to be stable to light at 27°C for at least a year. The encapsulation of CBAE in beads has provided a means to enhance the stability of all coloured CBAE towards heat and light. This is possible due to the stabilizing effect of alginate matrix on the CBAE. Blank and coloured macro-CAB and CCAB were spherical shapes with some dimples and pores. Blank and coloured micro-CAB and CCAB were irregular and tended to agglomerate probably due to the specific localization of the polymers and existence of attractive electrostatic forces. Result of SEM, FTIR and DSC indicated interactions of the components namely CBAE, alginate and chitosan in the beads.

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CHAPTER ONE

INTRODUCTION

The appreciation of good quality food and drink is one of life's great pleasures. Colour plays an important role in our enjoyment of foodstuffs; it is appreciated both for its aesthetic role and as a basis for the assessment of quality. Colour gives visual cues to flavour identification and taste thresholds, influencing food preference, food acceptability and ultimately food.

Recently, demands for natural food colourant are increasing as most of the synthetic colourants can contribute to the health problem such as cancer. Nowadays, consumer trends have shown desirability towards processed food containing no synthetic additives. Anthocyanins, which are the most targeted group of pigments, belong to the flavonoid family of phenolics and are responsible for the red, purple, and blue colours of many fruits, vegetables, cereal grains, and flowers (Harborne, 1964 & Calvo, *et al.*, 2000). Anthocyanins have great potential to be used as natural additives and have been chosen as one of the alternative to the synthetic dye. They are used as food additives in the production of soft drinks and wine. It has been shown that anthocyanins in many plants are good sources for improving health such as enhancement of sight acuteness, antioxidant capacity, controlling diabetes and others (Calvo, *et al.*, 2000, Kim, *et al.*, 2008 & Gulcin, 2003). The use of anthocyanins as natural food colourant has been studied for many years due to their availability.