DEVELOPMENT OF pH-SENSITIVE GELATIN-BASED INTELLIGENT FILM INCORPORATING DRAGON FRUIT SKIN POWDER

by

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LIST OF ABBREVIATIONS

Abbreviation	Caption
ΔE	Total difference color
°C	Degree Celcius
A	Absorbance
a*	hue a
ATR-FTIR	Attenuated Total Reflectance-Fourier Transform Infrared
b*	Chroma b
$CH_3CO_2Na \cdot 3H_2O$	Sodium acetate
cm	centimetre
Cu	Copper
d	Film thickness (mm)
DF	Dilution factor
DFS	Dragon fruit skin
DFBG	Dragon fruit/bovine gelatin
DFBG0	Dragon fruit/bovine gelatin film without addition of dragon fruit skin extract
DFBG1	Dragon fruit/bovine gelatin with addition of 5% v/v dragon fruit skin extract
DFBG2	Dragon fruit/bovine gelatin with addition of 10% v/v dragon fruit skin extract
DFBG3	Dragon fruit/bovine gelatin with addition of 15% v/v dragon fruit skin extract
ε	Molar absorptivity constant
FTIR	Fourier Transform Infrared

g	gram
GAB	Guggenheim Anderson-Boer
HCl	Hydrogen chloride
hr	hour
K	Potassium
KCl	Potassium chloride
KCO_3	Potassium carbonate
KNO_3	Potassium nitrate
L	Litre
L*	Lightness
mg	milligram
mL	millilitre
mm	millimetre
min	minute
$MgCl_2$	Magnesium chloride
$MgNO_3$	Magnesium nitrate
MW	Molecular weight
NaCl	Sodium chloride
nm	nanometer
RH	Relative humidity
RH_1	Relative humidity of dessicator
RH_2	Relative humidity of permeation cell
rpm	revolution per minute
S	Saturated water vapour pressure at test temperature (Pa)
SEM	Scanning electron microscope

UV	Ultraviolet
UV-Vis	Ultraviolet visible region
v/v	Volume per volume
W_i	Initial weight of film
W_f	Final weight of film
W_t	Weight of film at certain time
WS	Water solubility
WVP	Water vapour permeability
WVTR	Water vapour transmission rate

ABSTRAK

Dalam kajian ini, filem pintar berasaskan gelatin yang menggabungkan serbuk antosianin dari kulit buah naga (DFS) (*Hylocereus polyrhizus*) disiapkan sebagai petunjuk untuk kesegaran makanan. Ia disediakan untuk menilai kesan serbuk DFS terhadap sifat mekanikal, penyerapan kelembapan dan juga sifat kepekaan pH filem. Filem-filem itu dibuat dengan menggunakan teknik 'casting' dan dilabelkan sebagai DFBG bersesuaian dengan isi pengekstrakan yang berbeza. Filem DFBG ini dicirikan oleh 'Fourier transform infrared' (FTIR) dan mikroskopi elektron pengimbasan (SEM). Kandungan kelembapan, sifat mekanik, kelarutan air, kebolehtelapan wap air, transmisi cahaya, penilaian warna dan penginderaan pH ditentukan untuk menilai kemungkinan penerapannya. Spektroskopi FTIR mendedahkan bahawa antosianin dalam ekstrak dapat berinteraksi dengan komponen filem lain melalui ikatan hidrogen. SEM juga menunjukkan bahawa dengan penambahan ekstrak, filem yang dipamerkan menjadi halus dan memberikan permukaan yang jelas. Penggabungan antosianin dari serbuk DFS telah meningkatkan kandungan kelembapan, ketebalan dan kelarutan air filem, tetapi menurunkan kekuatan tegangan, kebolehtelapan wap air dan pemancar cahaya filem. Filem-filem tersebut menunjukkan ΔE yang lebih besar dengan peningkatan jumlah ekstrak yang menunjukkan bahawa filem-filem tersebut menghasilkan perubahan warna yang baik. Namun, tidak ada perubahan yang signifikan terjadi ketika filem tersebut didedahkan dengan larutan pH yang berbeza. Lebih banyak larutan 'buffer' diperlukan untuk memerhatikan perubahan warna filem. Oleh itu, kajian ini menunjukkan bahawa filem DFBG3 yang menunjukkan hasil yang baik dapat digunakan untuk memantau kesegaran makanan.

ABSTRACT

In this study, gelatin-based intelligent film incorporating anthocyanin from dragon fruit skin (DFS) powder (Hylocereus polyrhizus) was prepared as an indicator for food freshness. It was developed to evaluate the effects of DFS powder on its mechanical properties, moisture sorption properties and also the pH sensitivity properties of the films. The films were made by using the casting technique and labeled as dragon fruit bovine gelatin (DFBG) according to the different extraction content. DFBG films were characterized by Fourier transform infrared spectroscopy (FTIR) and Scanning electron microscopy (SEM). The moisture content, mechanical properties, water solubility, water vapour permeability, light transmittance, color and pH-sensing evaluations were determined to evaluate its potential applications. FTIR spectroscopy revealed that the anthocyanin in the extract can interact with the other film components through the hydrogen bonds. SEM also presented that with the addition of the extract, the films exhibited to be smooth and give a clear surface to the films. The incorporation of anthocyanin from DFS powder had increased the moisture content, thickness and water solubility of the films, but decreased the tensile strength, water vapour permeability and light transmittance of the films. The films showed to give larger ΔE with an increased amount of the extract indicated that the films produced good color variability. However, no significant changes happened when the films were exposed to different pH buffer solutions. More buffer solutions were needed in order to observe the color changes of the films. This study, therefore, indicated that DFBG3 film which showed to give good results can be used to monitor the freshness of food.