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Supplementary material

SUPPLEMENTARY MATERIAL TO

The feasibility of *Cassia fistula* gum with polyaluminum chloride for the decolorization of reactive dyeing wastewater

YUAN SHING PERNG and MANH HA BUI*

Department of Environmental Engineering, Dayeh University, No.168, University Rd., Dacun, Changhua- 51591, Taiwan, China

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CHARACTERIZATION OF *CF* GUM

Fourier transform infrared (FTIR) spectrum of CF *gum*

The infrared spectrum of the *CF* gum was measured on a Bruker Equinox 55 FTIR spectrometer in the form of tablets KBr pellets. The spectrum was recorded from 400 cm^{-1} to 4000 cm^{-1} with 64 scans collected at a resolution of 4 cm^{-1}.

The infrared spectrum of *CF* gum shown in Fig. S-1 indicates the typical peak characteristic of polysaccharides and confirms the presence of many similar sugar residues.

The broad band of 950 to 1151 cm^{-1} is assigned to galactomannan composition in gum by the contribution of bending C–OH modes. The peak at 1151 cm^{-1} results from stretching modes of the C–O present in the pyranose ring while the absorption peaks at 1026 and 1093 cm^{-1} correspond to bending vibrational modes of C–OH. In the anomeric region (700 to 950 cm^{-1}), the obvious peaks at 814 and 875 cm^{-1} reveal the presence of α-linked D-galactopyranose and β-linked D-mannopyranose unit, respectively. These bands identified a galactomannan polysaccharide structure with the same characteristics as in a previously published study.[1]

Carbohydrate profile

The constituent saccharides (mannose and galactose) were measured by HPLC under following conditions: 250 mm×4.6 mm i.d. NH_2P-50 column (Asahi Kasei Ltd.), mobile phase including water:acetonitrile of 20:80, flow rate 0.6 mL min^{-1} and with a refractive index (RI) detector at 25 °C.

The resulting chromatogram is depicted in Fig. S-2, which shows that the average molar ratio of mannose to galactose in the *CF* gum was about 3.5:1. This

* Corresponding author. E-mail: manhhakg@yahoo.com.vn

seems to be quite consistent with the result of Ali *et al.*[2] This ratio indicates a limited solubility of this gum in water due to the formation of strong intramolecular hydrogen bonds.

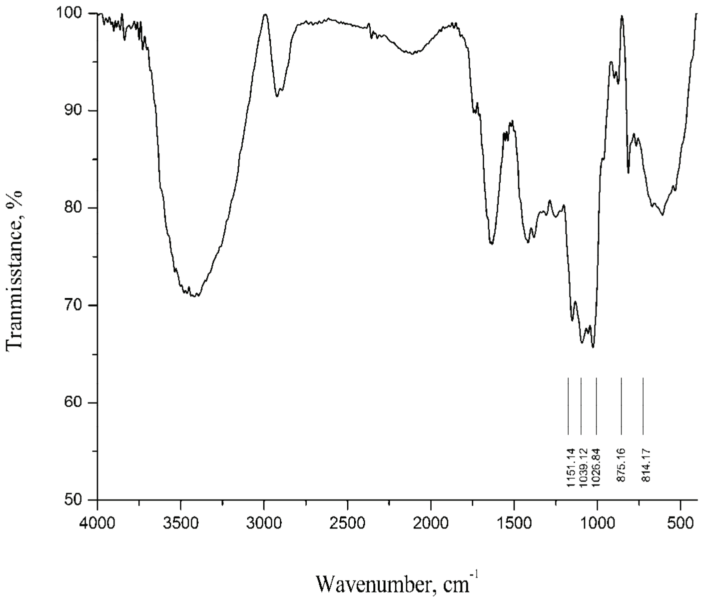


Fig. S-1. FT-IR spectra of the *CF* gum.

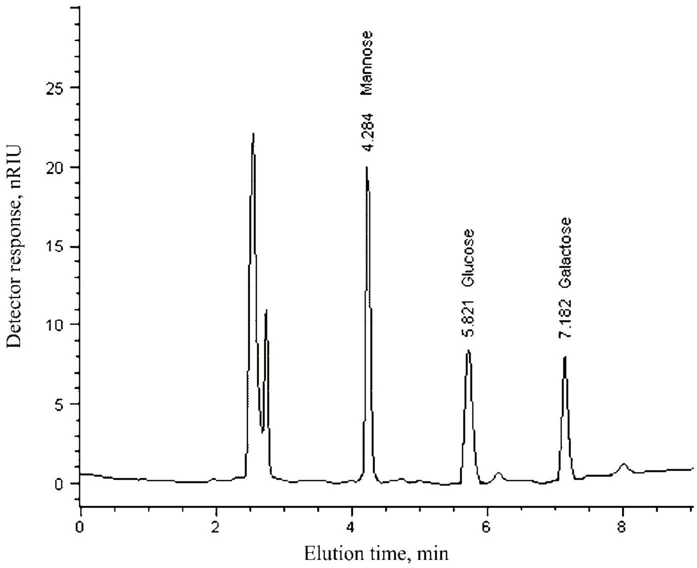


Fig. S-2. HPLC profile of the hydrolyzate of the crude *CF* gum.

Molar mass determination of the CF *gum*

The number-average molar mass ($\bar{M}_n$) and weight-average molar mass ($\bar{M}_w$) of the samples were determined by gel permeation chromatography (GPC) with an Agilent instrument (serial LC 1100) using an ultrahydrogel linear column (7.8 i.d.×300 mm, Waters, USA), a flow rate of 0.6 mL min^{-1}, a *CF* gum concentration of 2 mg L^{-1}, water as the solvent and $NaHCO_3$ buffer (pH 11) as the eluent using an RI detector at room temperature.

The GPC chromatogram of the *CF* gum is presented in Fig. S-3. The weight-average molar mass ($\bar{M}_w$) of the *CF* gum was 4.70×10^5 g mol^{-1} and the polydispersity index (*D*) was 2.483. The weight value was lower, but the *D* value of this gum was higher than the values for other galactomannans extracted from some plant sources, such as *Dimorphandra gardneriana*[3] ($\bar{M}_w$ 3.9×10^7 g mol^{-1}, *D* 2.06), *Caesalpinia ferrea*[4] ($\bar{M}_w$ 6.04×10^5 g mol^{-1}, *D* 1.55) and *Mimosas cabrella*[5] ($\bar{M}_w$ 8.48×10^5 g mol^{-1}, *D* 1.3). Thus, the *CF* gum could dissolve faster than the gums investigated in other studies. However, this product needs to be purified or subjected to some modification steps to become a commercial coagulant.[5,6]

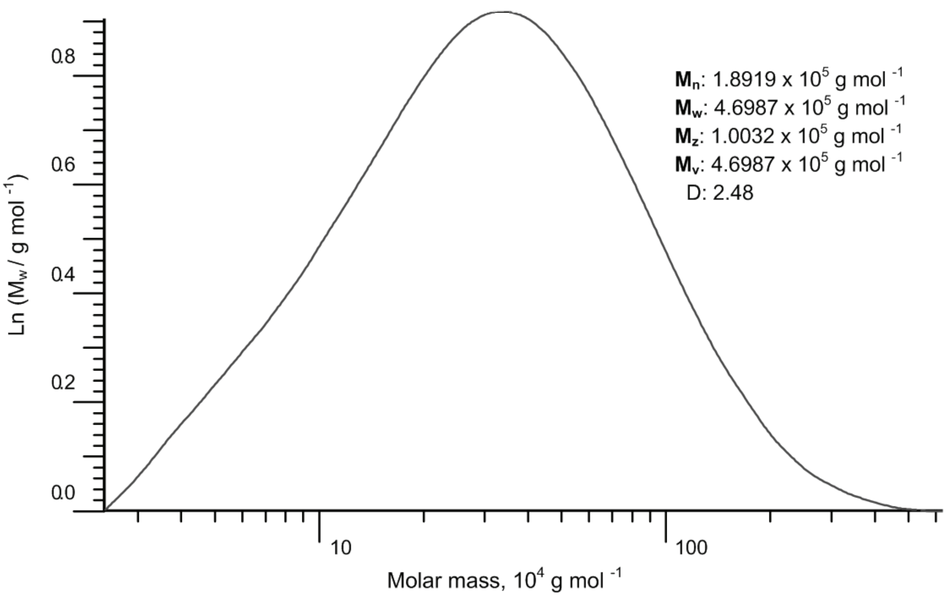


Fig. S-3. Molecular weight distribution of the *CF* gum.

RESULTS FOR THE OPTIMIZATION OF THE REMOVAL OF THE DYES

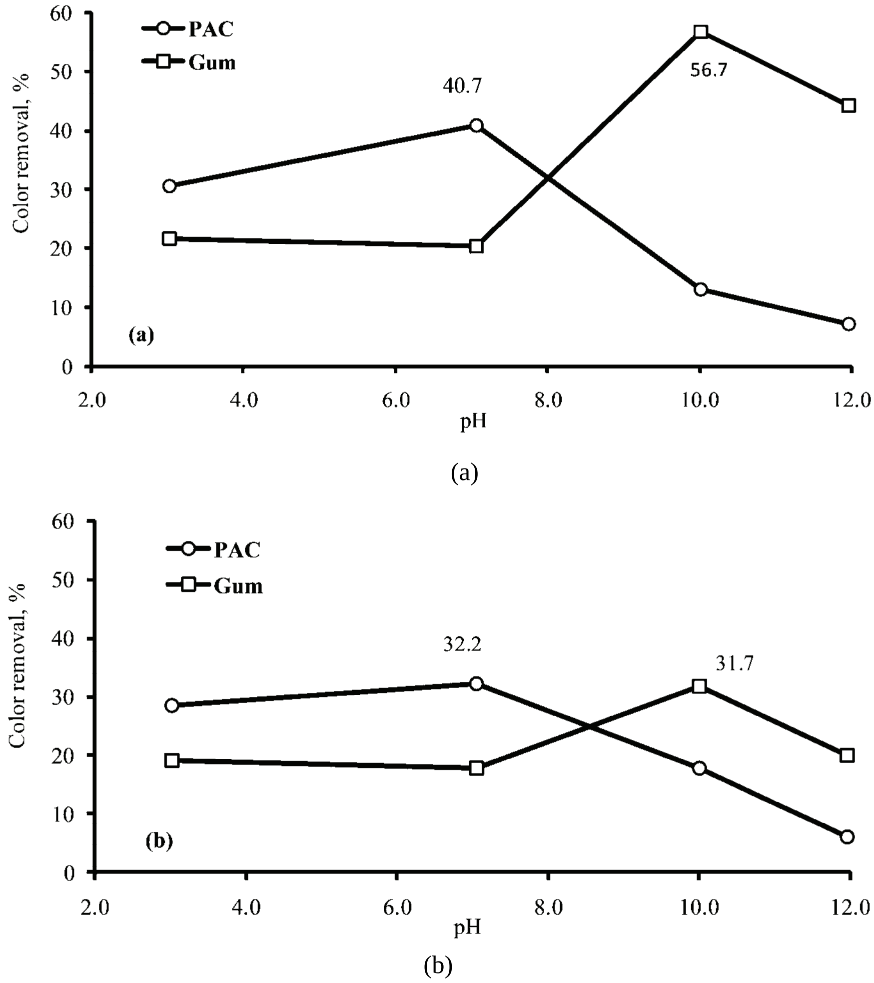
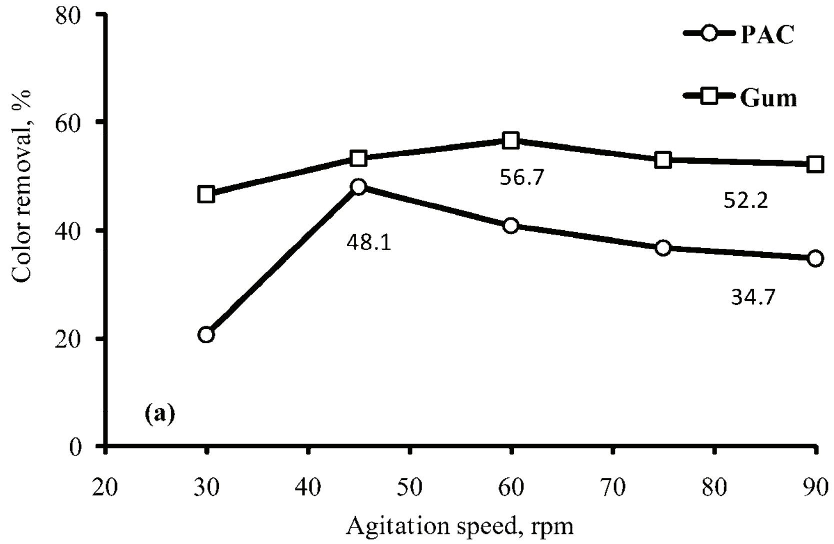
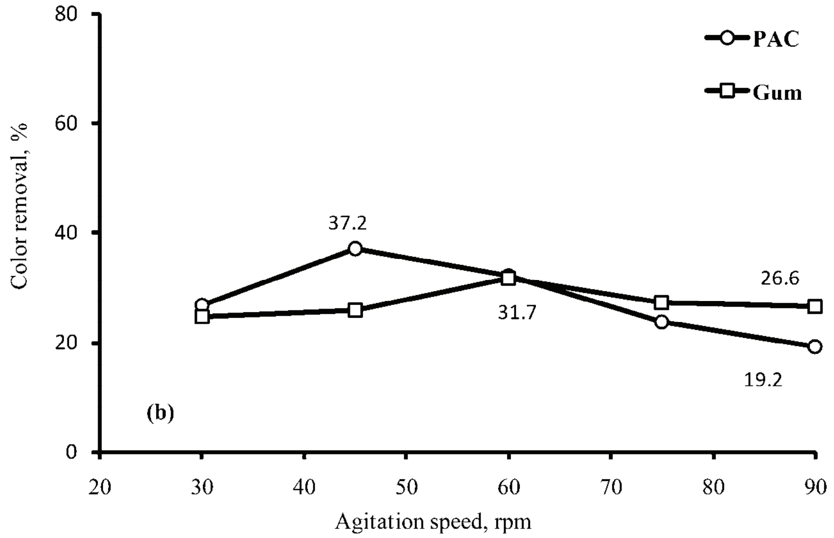


Fig. S-4. Effect of pH on the color removal for a) RB19 and b) RB5.



(a)



(b)

Fig. S-5. Influence of agitation speed on color removal for a) RB19 and b) RB5.

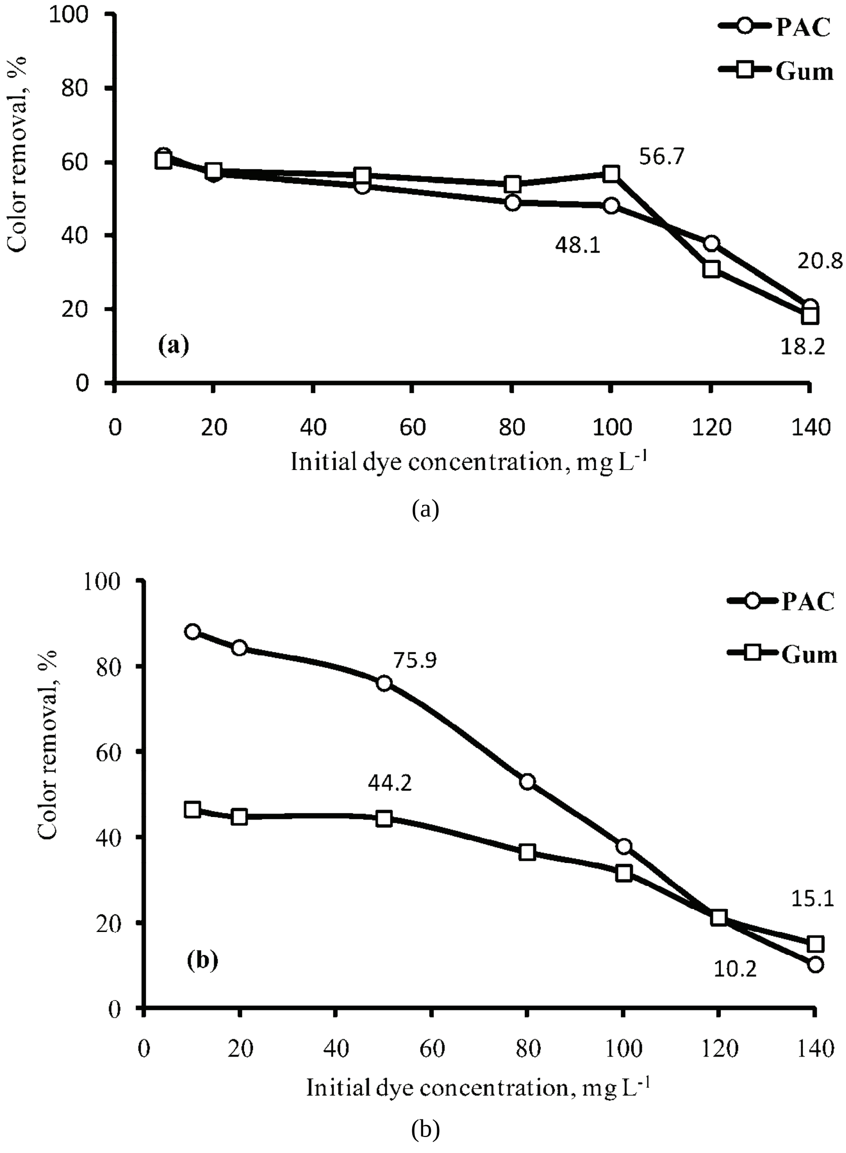
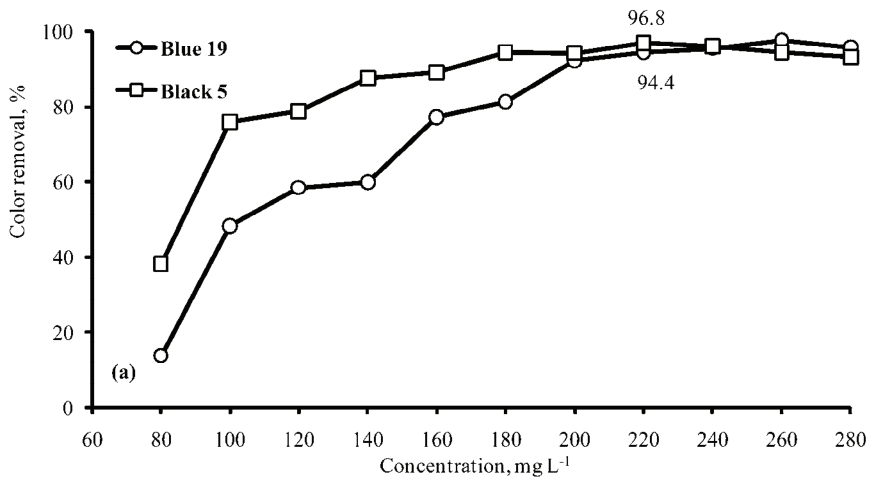
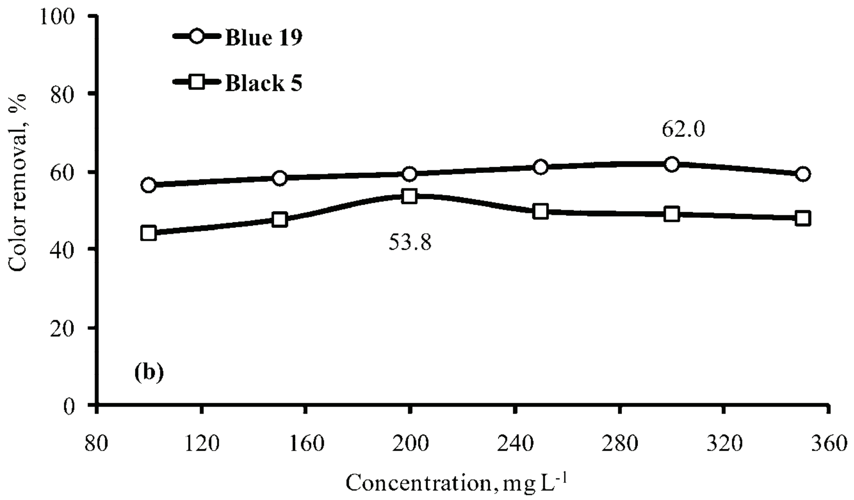


Fig. S-6. Effect of initial dye concentration on color removal for a) RB19 and b) RB5.



(a)



(b)

Fig. S-7. Effect of coagulant concentration on dye removal efficiencies for a) PAC and b) gum.

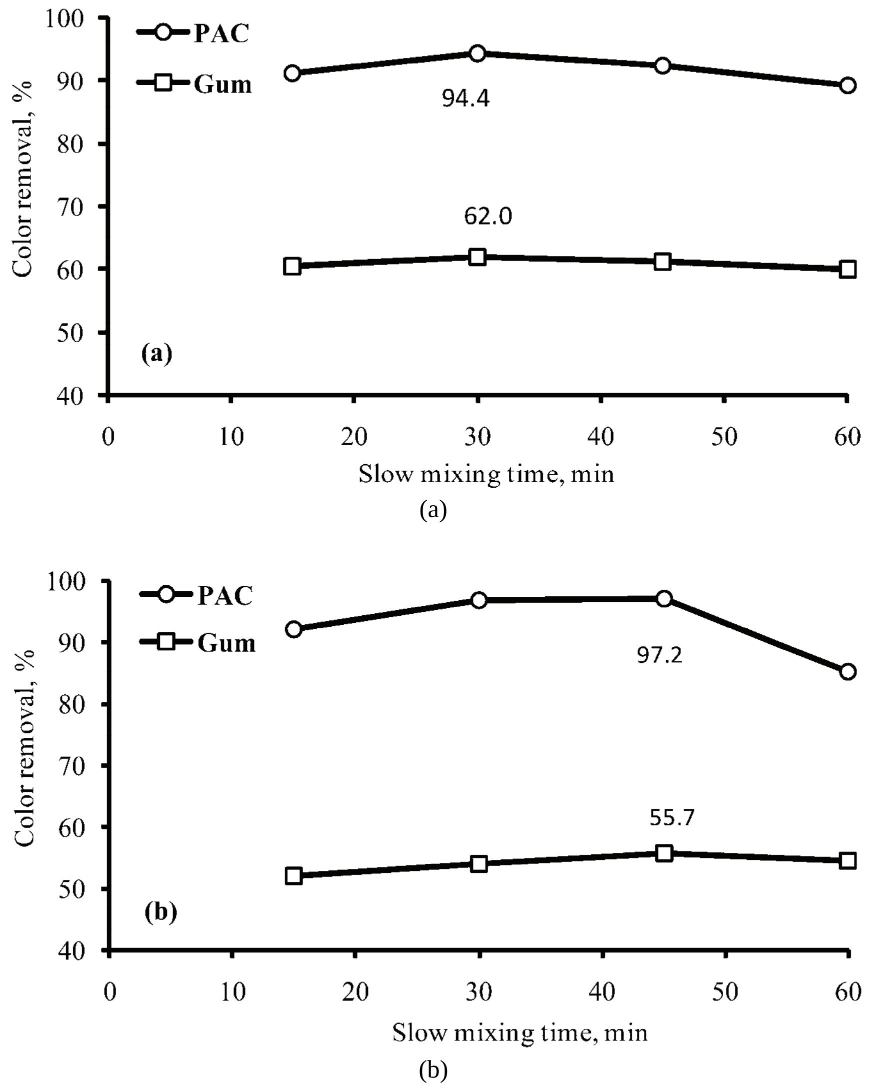


Fig. S-8. Effect of reaction time on dye removal efficiencies for a) RB19 and b) RB5.

Table S-I. Volume fractions and associated concentrations of each coagulant

Dye	Gum			PAC	
	Volume fraction %	Volume mL	Mass concentration mg L^{-1}	Volume mL	Mass concentration mg L^{-1}
Blue 19	0	0	0	50	220
	10	5	20	45	198
	20	10	40	40	176
	30	15	60	35	154
	40	20	80	30	132
	50	25	100	25	110
	60	30	120	20	88
	70	35	140	15	66
	80	40	160	10	44
	90	45	180	5	22
	100	50	200	0	0
Black 5	0	0	0	50	220
	10	5	30	45	198
	20	10	60	40	176
	30	15	90	35	154
	40	20	120	30	132
	50	25	150	25	110
	60	30	180	20	88
	70	35	210	15	66
	80	40	240	10	44
	90	45	270	5	22
	100	50	300	0	0

REFERENCES

1. M. A. Cerqueira, B. W. S. Souza, J. Simões, J. A. Teixeira, M. R. M. Domingues, M. A. Coimbra, A. A. Vicente, *Carbohydr. Polym.* **83** (2011) 179
2. M. A. Ali, M. A. Sayeed, N. Absar, *J. Chin. Chem. Soc.* **51** (2004) 647
3. P. L. R. Cunha, Í. G. P. Vieira, Â. M. C. Arriaga, R. C. M. De Paula, J. P. A. Feitosa, *Food Hydrocoll.* **23** (2009) 880
4. C. F. De Souza, N. Lucyszyn, F. A. Ferraz, M. R. Sierakowski, *Carbohydr. Polym.* **82** (2010) 641
5. C. W. Vendruscolo, C. Ferrero, E. A. G. Pineda, J. L. M. Silveira, R. A. Freitas, M. R. Jiménez-Castellanos, T. M. B. Bresolin, *Carbohydr. Polym.* **76** (2009) 86
6. V. Singh, S. Tiwari, A. K. Sharma, R. Sanghi, *J. Colloid Interface Sci.* **316** (2007) 224.