LWT - Food Science and Technology 55 (2014) 426–435

Contents lists available at ScienceDirect

LWT - Food Science and Technology

journal homepage: www.elsevier.com/locate/lwt

Study of spray drying of the *Aloe vera* mucilage (*Aloe vera barbadensis* Miller) as a function of its rheological properties

C.V. Cervantes-Martínez [a], L. Medina-Torres [b,*], R.F. González-Laredo [a], F. Calderas [b], G. Sánchez-Olivares [c], E.E. Herrera-Valencia [b], J.A. Gallegos Infante [a], N.E. Rocha-Guzman [a], J. Rodríguez-Ramírez [d]

[a] Departamento de Ingenierías Química y Bioquímica, Instituto Tecnológico de Durango, Blvd. Felipe Pescador 1830 Ote., 34080, Durango, Dgo., Mexico
[b] Facultad de Química, Departamento de Ingeniería Química, Conjunto E Universidad Nacional Autónoma de México (UNAM), México D.F., 04510, Mexico
[c] CIATEC, A.C., Omega 201, León, Gto., 37545, Mexico
[d] Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional Unidad Oaxaca, Hornos No. 1003, Col. Noche Buena, Santa Cruz Xoxocotlán, C.P. 71230, Oaxaca, Mexico

ARTICLE INFO

Article history:
Received 8 July 2013
Received in revised form
4 September 2013
Accepted 27 September 2013

Keywords:
Rheological properties
Viscoelasticity
Mucilage
Aloe vera
Spray drying

ABSTRACT

Spray Drying (SD) was used to obtain *Aloe vera* powder from fresh plants. The powder was reconstituted in an aqueous medium and its rheological properties, particle size distribution (PSD), thermal properties (differential scanning calorimetry, DSC), and morphology (scanning electron microscopy, SEM) were evaluated in order to find an alternative to natural gum to be used in the food industry. Rheological measurements were conducted at 25 °C in aqueous concentrations of 3 g/100 mL and 6 g/100 mL. A 2^3 factorial design was used with three central points to evaluate yield, efficiency and the rheological properties of reconstituted powders, results were compared with a liophilized (FD) sample of *A. vera* mucilage. Experimental results showed that the shear viscosity decreased with the increase of the inlet air temperature and the speed of atomization, and it increased with increasing feed flow in SD. Additionally, most powders obtained in all treatments have an average particle diameter of ~10 μm with a modal distribution (PSD). The best conditions of SD in order to obtain a good thickening agent were: 150 °C inlet temperature, 1.5 L/h feed rate and atomization speed of 275,000 rpm, and with rheological properties very close to those of the FD sample.

1. Introduction

Due to the concern and current interest of people in their health and quality of life, there has been an increasing demand for natural products, which has impelled pharmaceutical and natural products industries to focus their research on products with functional properties. A raw material that currently has potential in this field is *A. vera*, a kind of cactus from which cosmetics, pharmaceuticals and chemistry products can be obtained. *A. vera* is considered to be a potential source of gums and/or hydrocolloids (Sánchez González, Vargas, González-Martínez, Cháfer, & Chiralt, 2008). The selection of new sources of biopolymers requires a thorough understanding of the rheological properties and physicochemical characteristics of natural chemistries (García-Cruz, Rodríguez-Ramírez, Méndez-Lagunas, & Medina-Torres, 2013). These properties of the gum are sensitive to separation methods and they can be significantly altered with the drying process (Wang, Wang, Li, Xue, & Mao, 2009). It has been shown that this plant can provide nutritional components as feedstock for the production of functional products, considered the chemistry of the future (Vega, Ampuero, Díaz, & Lemus, 2005). *A. Vera* is a plant that has great range for adaptation to the environment due to its high rate of water retention, allowing it to form a dense layer of gel, which contains 99.4 g/100 g water and 0.6 g/100 g of solids, there are at least four different partially acetalized sugars in its composition that differ in the radius of the glucose and mannose (Vega, Uribe, Lemus, & Miranda, 2007). This plant has a composition of equal proportions of D-glucose and D-mannose (76 g/100 g), with 24 g/100 g of uronic acid, the juice contains 55.2 mg of polysaccharides per 100 mL of juice. The approximate total mass of polysaccharides is 788 mg/L (Rodríguez-González, Femenia, Minjares-Fuentes, & González-Laredo, 2010). Femenia, Sánchez, Simal, and Rosselló (1999) and Femenia, García-Pascual, Simal and Rosselló (2003) reported that the polysaccharides contained in the parenchyma of the *Aloe* are of

* Corresponding author. Tel.: +52 5556225360; fax: +52 5556225329.
E-mail address: luismt@unam.mx (L. Medina-Torres).

0023-6438/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.lwt.2013.09.026