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Oxidized Tapioca Starch As an Alginate Substitute for Encapsulation of Antioxidant from Coffee Residue

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Abstract

Coffee residue had polyphenol content 18.180 mg/g, yet its extract contained 1.746 mg/g polyhenol. Oxidized tapioca had comparable characteristics to alginate as an encapsulant material. Suspension concentration for encapsulation preparation was 5% (w/v) (encapsulant material/antioxidant extract). Microcapsul which is made by 25% oxidized tapioca starch had loading capacity 33.18%, capsul particle size 1699.3 µm, moisture content 10.57%, polyphenol content 1.23% (db) and antioxidant activity 29.04%. This capsul had better properties than control which is made without oxidized starch substitution.

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Keywords: encapsulation; oxidized starch; alginate substitute; antioxidant

1. Introduction

Indonesia is the biggest fourth coffee producer in the world. Coffee is one of favorite drinks because its unique taste and good health effect for the consumers. Experimental data showed that coffee had high antioxidant activity (Daglia et al., 1994). Other works also showed that roasted coffee took role as an antioxidant and could prevent lipid peroxidation in model system (Stadler et al., 1994). Coffee residue is by product from instant coffee production. Higher demand on instant coffee products produce more waste of coffee residue. We calculate that for instant coffee processing which need 1 kg roasted coffee bean (moisture content 12-13%) resulted 0.743 kg coffee residue

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(moisture content 58.65%) or 0.312 kg (moisture content 4.24%). Yen et al. (2005) reported that coffee residue extract showed high antioxidant activity because it contained polyphenol and non-polyphenol compounds, which called MRPs. This compound can be acted as primary and secondary antioxidant. Products of Maillard Reaction (MRPs), which was produced during roasting process remained in coffee residue.

However, because of the presence of unsaturated bonds in their molecular structure, polyphenols are vulnerable to oxidants, light and heat, which can be easily deteriorated when exposed to these conditions. Therefore, it would be better to protect bayberry polyphenols by some forms from chemical damage by encapsulation. Microencapsulation is described as a technique , for example a bioactive compound, is encapsulated by a biopolymer which can protect the bioactive compound from oxygen, moisture or other stresses to improve its stability (Saénz et al., 2009). Microencapsulation by coacervation is accomplished by phase separation of one or many hydrocolloids from the initial solution and the subsequent deposition of the newly formed coacervate phase around the active ingredient suspended or emulsified in the same reaction media (Gouin, 2004).

Sodium alginate is soluble in water and can form gel beads by dropping an aqueous solution into a divalent or polyvalent cation solu-tion (e.g. Ca2+, Zn2+) to encapsulate active compounds (Draget et al., 1998; George & Abraham, 2006). Although this is a simple and fast way of obtaining encapsulation systems, the method presents a major limitation consisting in loss during bead preparation. Active compound losses are favor by both, the time necessary for the cation to diffuse into the bead and the compound concentration gradient between the beads and surrounding solution. Besides, the presence of macropores in the alginate matrix facilitates the diffusion of hydrophilic molecules (George & Abraham, 2006; Gouin, 2004). However, some researchers were able to solve this problem by mixing alginate with other polymers such as starch, chitosan, cellulose, pectin, among others. In some cases, mechanical and physical properties of beads have been improved, as well (Chan et al., 2011; Santagapita et al., 2012).

Oxidized starch is starch which reacted with oxidizing agent, therefore oxidized starch is less viscous because the starch polymer have been degraded (Bertolini et al., 2001; Dias et al., 2011; Sangseethong et al, 2010; Rivera, 2005) and has higher solubility (Lorlowhakarn et al., 2005 dan Sandhu et al., 2008). These properties promote oxidized starch as suitable candidate for encapsulation matrix. Oxidation product of starch is carboxilate group which has anionic charge (Wurzburg, 1995), so the oxidized starch also makes matrix with divalent or polyvalent cation solution, such as $CaCl_2$. Some oxidized starch have been tried as an encapsulant material, such as oxidized corn starch and oxidised amaranth starch (Kshirsagar, 2008). However application of oxidized tapioca as wall material has not been examined, especially for antioxidant encapsulation of coffee residue extract.

2. 2. Materials and Methods

2.1. Materials

Coffee residue kindly provided by ICCRI Jember, Indonesia (Indonesian Coffee Cacao Research Institution) which is its extract was used as a core. The coating material were combination Alginic acid sodium salt (Sigma) and oxidized stacrh. The oxidized starch was made from commercial tapioca (Brand “99”, Malang, Indonesia) that then was oxidized by hydrogen peroxide. All chemicals used in this study were analytical grade. Purified water was used for the preparation of all solution. All experiments and analysis were carried out in triplicate.

2.2. Preparation of oxidized tapioca

The oxidized tapioca was prepared by following Palupi et al. (2011) method. The tapioca slurry (42g/100ml) was prepared with distilled water and maintained at room temperature. The pH was maintained at 7 by adding NaOH 2N followed with continous stirring for 15 minutes. Hydrogen peroxide was added in the slurry with concentration 1.5% (v/v) accompanied continous stirring for 60 minutes. Then the slurry was sentrifuged to get the starch and the supernatant was decanted. The oxidized starch was dried in convection oven at 50°C for 20 h then was kept in sealed box at room temperature.