SINTESIS DAN KARAKTERISASI HIDROGEL PVA/GA/POM/CNT, DAN UJI KINERJANYA SEBAGAI MATERIAL S-CRF $CaCl_2$ DAN S-CRF $ZnCl_2$

diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains pada Program Studi Kimia

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LEMBAR PENGESAHAN

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ABSTRAK

Penggunaan pupuk berlebih dalam praktek pertanian berpotensi menimbulkan *leaching* nutrien berlebih dan dapat mencemari lingkungan. Penggunaan material *Controlled Release Fertilizer* (CRF) berbasis hidrogel menjadi salah satu solusi untuk mengatasi isu tersebut. Mekanisme pelepasan pupuk dari CRF melibatkan penetrasi air ke dalam polimer pembentuk gel dan inti pupuk sehingga nutrien mampu lepas (*release*) ke tanah secara bertahap pada waktu tertentu. Penelitian ini bertujuan untuk mengkaji pergerakan ion Ca^{2+} dan Zn^{2+} (sebagai mikronutrien tanaman) dari dalam hidrogel PVA/GA/POM (PGP) dan PVA/GA/POM/CNT (PGPC) ke medium akuades. Hidrogel PGPC disintesis menggunakan prekursor Polivinil Alkohol (PVA) 3%, *crosslinker* glutaraldehida (GA) 1,25%, ekstrak *Premna oblongifolia Merr.* (POM) 1%, dan dispersi *functionalized* MWCNT dengan perbandingan volume 15:7,5:15:7 mL. Karakteristik hidrogel ditentukan berdasarkan hasil pengukuran FTIR, SEM, porositas dan sudut kontak. Pengukuran kinerja hidrogel sebagai CRF dilakukan dengan mengukur *swelling ratio, water retention*, serta kemampuan absorpsi dan desorpsi nutrien secara konduktometrik. Hasil karakterisasi menunjukkan bahwa dengan penambahan MWCNT ke dalam campuran prekursor PVA, GA, dan POM tidak terjadi interaksi secara kimia; namun mengubah morfologi hidrogel menjadi lebih kasar dan berpori; meningkatkan sifat hidrofilisitas (penurunan sudut kontak air dari 48,27^{o} menjadi 43,68^{o}); dan porositas (dari 66.85% menjadi 76,71%). Penambahan MWCNT juga mampu meningkatkan nilai *swelling ratio* (dari 673,9% menjadi 966,4%) dan *water retention* (dari 0,18% menjadi 3,53%); tetapi dapat mengurangi kemampuan absorpsi terhadap nutrien $CaCl_2$ dan $ZnCl_2$. Hasil uji *release* nutrien mengindikasikan bahwa nutrien lebih cepat keluar dari hidrogel PGPC dibandingkan PGP, sedangkan pada konsentrasi yang sama ditemukan bahwa $CaCl_2$ lebih mudah terdesorpsi dari kedua hidrogel dibandingkan dengan nutrien $ZnCl_2$.

Kata Kunci: $CaCl_2$, *Controlled Release Fertilizer*, glutaraldehida, hidrogel, konduktometri, MWCNT, polivinil alkohol, POM, dan $ZnCl_2$

ABSTRACT

Fertilizer overuse in agriculture practice can cause excessive leaching of nutrient and lead to environmental damage. A hydrogel-based Controlled Release Fertilizer (CRF) is used to solve these issues. The mechanism of release fertilizer from CRF involves the penetration of water into the gel-forming polymer and fertilizer core, so the nutrients are able to release gradually at certain time. The purpose of this study is to describe the movement of Ca^{2+} and Zn^{2+} ions (as plant's micronutrients) from PVA/GA/POM (PGP) and PVA/GA/POM/CNT (PGPC) hydrogels into aquadest medium. The PGPC hydrogel was synthesized using 3% Polyvinyl Alcohol (PVA), 1,25% glutaraldehyde (GA) as a crosslinker, 1% Premna oblongifolia Merr. (POM) extract, and functionalized MWCNT dispersion with the volume ratio 15:7,5:15:7 mL. Hydrogel's characteristics were determined based on the measurement from FTIR, SEM, measurement of porosity, and water contact angle. Hydrogel's performance as a CRF was carried out by measuring the swelling ratio, water retention, as well as the absorption and desorption ability of nutrients by using conductometric method. The characterization results showed that addition of MWCNT to the mixture of PVA, GA, and POM precursor did not cause any chemical interaction; the morphology of hydrogel became more porous and rough; increase the hydrophilicity (with decrease of water contact angle from 48,27^o to 43,68^o); and porosity (66,85% to 76,71%). And also, the addition of MWCNT was able to increase the hydrogel's performance in swelling ratio (from 673.9% to 966.4%); water retention (from 0.18% to 3.53%); but can decrease the absorption ability of $CaCl_2$ and $ZnCl_2$ nutrient. Nutrient release performance test indicated that nutrients will release more quickly from the PGPC hydrogel than from the PGP hydrogel. Meanwhile, at the same concentration, it was found that $CaCl_2$ nutrient was more released easier than $ZnCl_2$ nutrient from both the hydrogel.

Keywords: *Hydrogel, Controlled Release Fertilizer, Polyvinyl alcohol, glutaraldehyde, POM, MWCNT, conductometric, $CaCl_2$ dan $ZnCl_2$*

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