Preparation of microparticulate delivery systems based on chitosan and clay-KNO_3 by spray drying technique

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Abstract

Development of a hybrid biopolymer by spray drying technique for controlled release of KNO_3 fertilizer. Potassium nitrate (KNO_3) added to hybrid was characterized by FTIR and SEM.

Introdution

The development of new release systems in agricultural inputs has been shown extensively in the literature due to the need to strengthen the production systems by enhancing productivity and reducing costs [1]. Microparticle systems are among the different alternatives to obtain the control of the fertilizer delivery [2]. In this work we used microparticles of chitosan-clay fertilizer system obtained by spray drying technique. The chitosan solutions were prepared as follow: Chitosan (4% w/v) was dissolved in acetic acid (2% w/v) using mechanical stirrer and after 24 hours a dispersion of clay-nutrient (4 and 12 %w/v) were added and stirred in a *Turrax* (QAFT) or mechanical stirrer (QAFM) for 60 minutes. The feed solutions were dried in a Mini Spray Dryer B-290-BUCHI and the set of parameters as inlet temperatures, pump, aspiration rate and flow meter were 180 ºC, 40% (12mL/min), 36 m^3/h and 0.41 bar.

Results e Discussion

The sample QAFM (Figure 1) shows microparticles with lower homogeneity and it was observed the clay was not completely covered by the phase of chitosan and is outside of the microspheres.
Nevertheless, QAFT sample (Figure 2) shows better uniformity as observed by spherical particles in which the surface recovers the clay-nutrient phase.

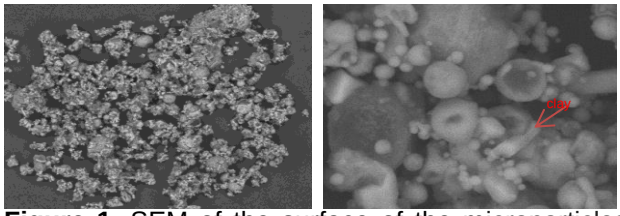

Figure 1. SEM of the surface of the microparticles prepared by mechanical stirrer.

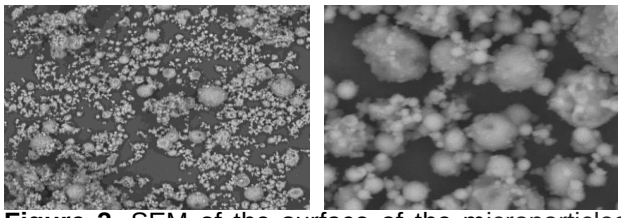

Figure 2. SEM of the surface of the microparticles prepared by a *Turrax* stirrer-homogeniser.

In the FTIR spectra of the hybrids (Figure 3I), it is possible to observe the bands of Chitosan (C=O vibration at 1650 cm^{-1}, deformation N-H at 1548 cm^{-1} and C-O stretch among 890-1150 cm^{-1}), Clay (Si-O stretching vibration at 1122 cm^{-1}) and KNO_3 (symmetric stretch N-O at 1380 cm^{-1}). The release behavior (Figure 3II) showed that micropaticles has a good profile KNO_3 release in water.

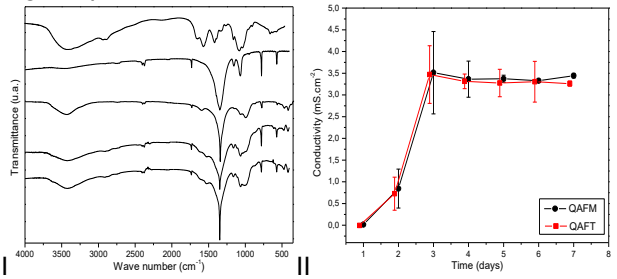

Figure 3: I - FTIR spectra of (a) Chitosan, (b) KNO_3, (c) Clay-nutrient, (d) QAFM and (e) QAFT; II - Release behavior of KNO_3 from QAFT and QAFM, in water measured by conductivity.

Conclusion

The preparation via spray dryer has shown promise for the preparation of microparticles loaded with agro-nutrients and good fertilizer release in water. Morphological and structural analysis indicated the presence of KNO_3 nutrient and also confirmed that the type of agitation is an important factor that directly influence the homogeneity of these systems.

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