Supporting information

Microorganisms-based monodisperse microcapsules: encapsulation of the fungicide tebuconazole and its controlled release properties

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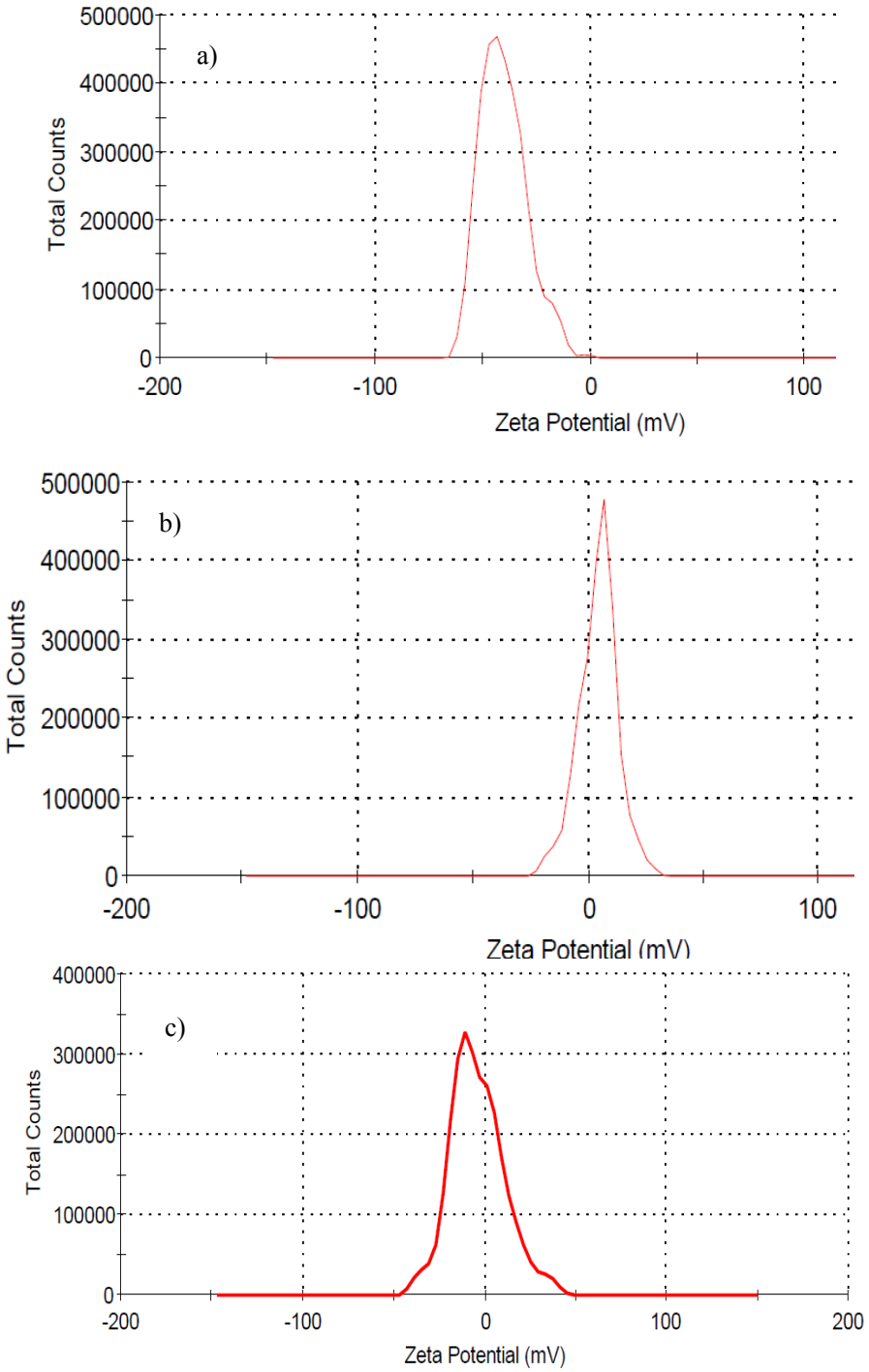

Figure S1. Zeta potential of the TEB-PCC spheres (a), UF prepolymers (b), and TEB-PCC@UF (c).

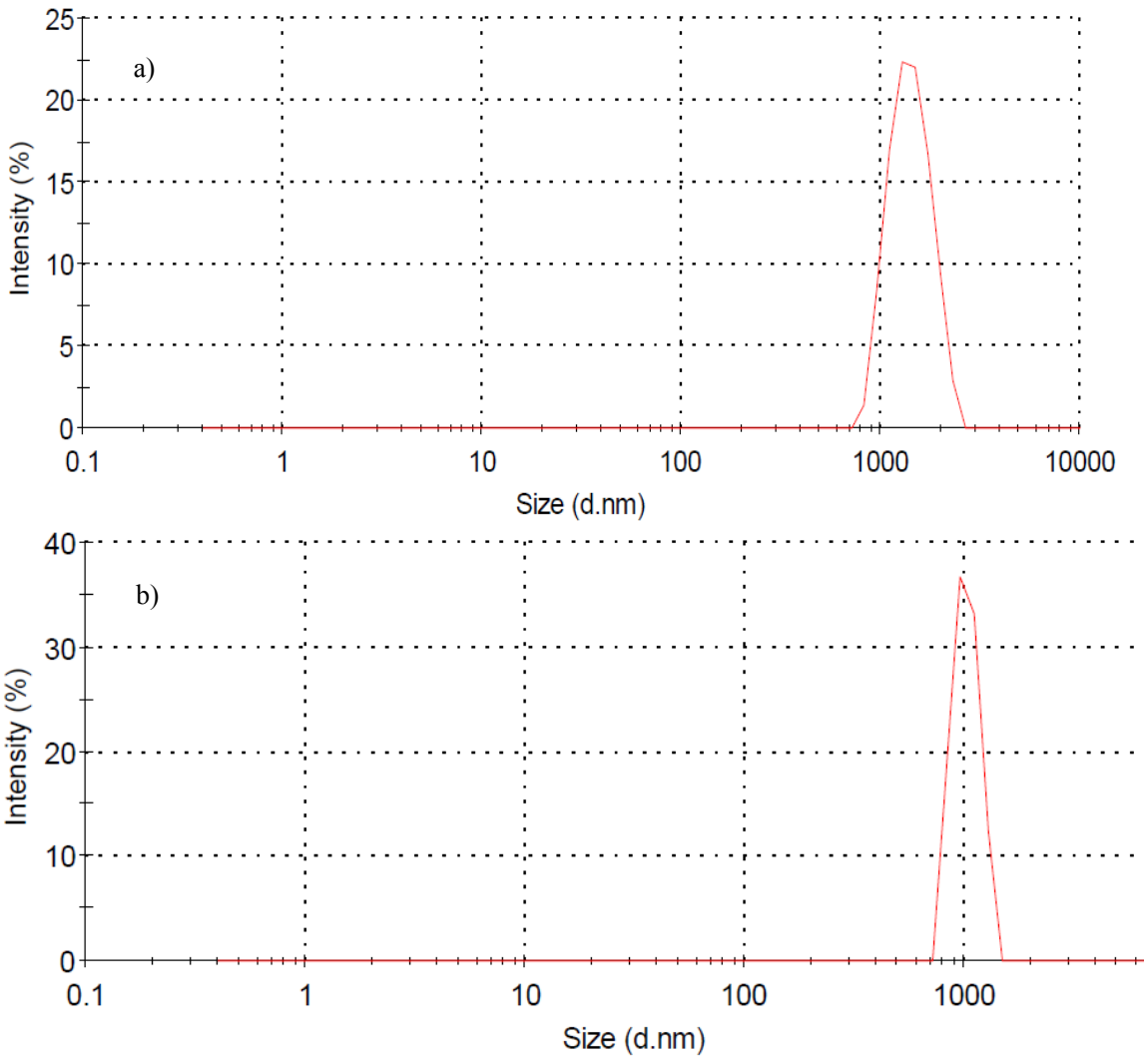

Figure S2. The particle size distribution curves of PCC 6803 (a), and TEB-PCC@UF (b).

Adsorption isotherm of tebu on Micy powder

As in previous reports,[1,2] the sorption isotherms were determined by batch equilibration of 0.05 g of PCC 6803 cells with 50 mL of aqueous solutions of tebu of varied initial concentrations (50.0-800.0 mg/L) in absolute ethanol. Experiments were carried out in a thermostatic shaker bath at 30 ± 0.1 ℃ for 24 h. Preliminary experiments were conducted for various time intervals to determine when sorption equilibrium was reached. The sorption equilibrium time required for tebu was less than 24 h. After equilibration, the equilibrium concentration and the adsorption amount of tebu was determined by UV-vis spectrophotometer as described in the kinetic studies above. Blanks without tebu and triplicates of each sorption point were used for each series of experiments

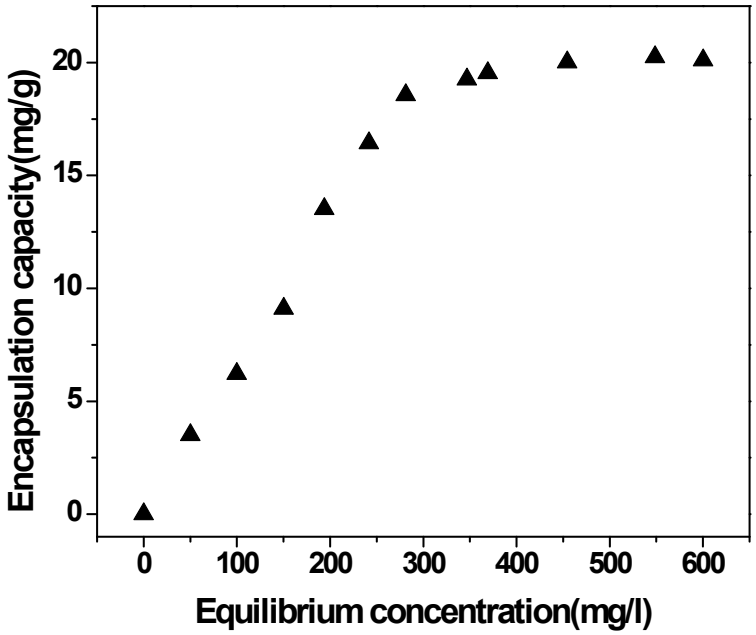

Figure S3. Absorption isotherms of TEB on PCC 6803 in isopropanol solvent

S4. The number density of active sites for TEB onto one PCC 6803 cell sphere

Density of active sites on PCC 6803 cells has a great influence on the adsorption capacity. In order to explore the density of active sites in PCC 6803 cell, the number of TEB molecules adsorbed onto each PCC 6803 cell ball surface was calculated by considering the PCC 6803 cell ball as a rigid sphere of equal size in three directions. Although the spherical particles of equal size have different packing arrangements,[3] we selected simple cubic packing model in this study for simplicity. In this model one sphere touches four other spheres, 52.4% of the volume is occupied and the remaining 47.6% of the volume is empty. According to the literature,[4] the bulk density (ρ) of PCC 6803 after vacuum pumping is 0.63 g/cm^3. Within 1 cm^3 of cube, the volume occupied (V_{total}) of PCC 6803 cell spheres is 0.52 cm^3. The volume V_{sphere} of a PCC 6803 cell sphere is as follows:

$$V_{sphere} = 4\pi r^3/3 = 1.68\times10^{-12}\ cm^3 \qquad (3)$$

Where r is the radius of the sphere, the average size of PCC 6803 cell spheres is 1.474 μm. The number N_1 of PCC 6803 cell spheres within 1 cm^3 of cube can be calculated as:

$$N_1 = V_{total}/V_{sphere} = 3.10\times10^{11} \qquad (4)$$

The number N_2 of 1 g of PCC 6803 cell spheres is obtained as:

$$N_2 = N_1/\rho = 4.92\times10^{11} \qquad (5)$$

The number N_3 of TEB molecules adsorbed onto 1 g of PCC 6803 cell spheres is given by:

$$N_3 = N_A\times Qe / M_{TEB} = 3.93\times10^{19} \qquad (6)$$

Where N_A is Avogadro constant (6.02×10^{23}); Qe is the adsorption amount of TEB on PCC 6803 cell in isopropanol (20.10 mg/g); M_{TEB} is molecular weight of TEB (307.8).

The number N_4 of TEB molecules adsorbed onto one PCC 6803 cell sphere can be calculated from:

$$N_4 = N_3 / N_2 = 7.99 \times 10^7 \quad (7)$$

Thus, the number density of active sites for TEB onto one PCC 6803 cell sphere is 7.99×10^7.

Table S1. Control efficacy of (a) TEB-PCC@UF microcapsules and (b) commercial formulation on wheat powdery mildew after 4, 8 and 12 day sprayed wheat at 24 h before inoculation.

Concentration (ppm)	Formulation	Control Efficacy[a] (%)		
		4d	8d	12d
2.5	a	56.50±1.22	53.75±1.40	46.25±1.12
	b	47.75±1.73	39.00±1.66	22.75±0.98
5	a	67.00±0.79	55.75±1.27	52.00±0.71
	b	62.00±1.32	45.75±1.08	27.50±0.89
10	a	77.50±2.10	77.50±1.31	77.75±1.92
	b	68.50±1.40	62.00±1.57	43.50±1.20
20	a	84.25±0.90	83.75±0.71	83.00±1.80
	b	75.25±1.37	71.25±1.60	52.00±1.90
30	a	91.75±1.80	80.75±1.37	81.75±2.10
	b	82.75±1.21	69.00±0.78	50.50±1.36
40	a	95.75±2.31	88.25±1.10	83.75±1.75
	b	91.00±2.10	75.25±1.53	51.00±2.14

[a] Values are the mean ± SD of three replicates.

Table S2. Control efficacy of (a) TEB-PCC@UF microcapsules and (b) commercial formulation on wheat powdery mildew after 4, 8 and 12 day sprayed wheat at 48 h before inoculation.

Concentration (ppm)	Formulation	Control Efficacy[a] (%)		
		4d	8d	12d
2.5	a	68.00±1.78	60.00±0.97	52.50±1.22
	b	49.25±2.10	39.50±0.66	20.50±1.54
5	a	69.25±1.50	70.00±2.21	69 .25±1.78
	b	64.25±1.47	59.00±2.18	34.25±1.40
10	a	81.00±2.20	81.00±1.85	78.50±1.60
	b	69.00±1.36	63.45±0.78	44.50±0.90
20	a	85.25±1.80	86.25±1.13	80.75±1.73
	b	78.50±2.61	72.25±1.62	52.50±2.30
30	a	92.25±1.80	84.50±2.31	81.75±1.85
	b	82.00±2.12	72.00±1.75	50.75±1.52
40	a	95.95±2.30	89.75±2.90	82.75±1.95
	b	92.75±1.17	76.00±2.45	51.25±2.30

[a] Values are the mean ± SD of three replicates.

Table S3. Control efficacy of (a) TEB-PCC@UF microcapsules and (b) commercial formulation on wheat powdery mildew after 4, 8 and 12 day sprayed wheat at 72 h before inoculation.

Concentration (ppm)	Formulation	Control Efficacy (%)		
		4d	8d	12d
2.5	a	63.00±1.52	56.25±0.95	43.50±1.70
	b	49.25±1.45	40.00±1.15	20.00±1.54
5	a	70.25±1.78	69.00±1.60	60.25±1.48
	b	65.25±1.90	61.00±2.21	36.25±2.32
10	a	81.50±1.82	81.25±2.15	69.50±1.35
	b	73.00±2.15	64.00±2.07	41.50±1.75
20	a	86.25±1.32	86.45±2.25	76.75±1.78
	b	79.50±0.95	73.00±1.20	53.50±2.01
30	a	93.00±1.82	85.50±1.57	76.75±2.20
	b	84.00±2.65	71.25±1.47	51.25±1.89
40	a	96.25±2.30	90.75±1.25	80.75±1.72
	b	92.45±2.12	77.00±1.20	52.25±1.68

[a] Values are the mean ± SD of three replicates.

References

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4 S. H. Ling, Solid Formulation, 3rd ed.; Chemical Industry Press: Beijing, China, 2003, pp 405.