江蘇科技大學

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Generation of α - linolenic acid emulsion droplet from silkworm pupae oil by microchips

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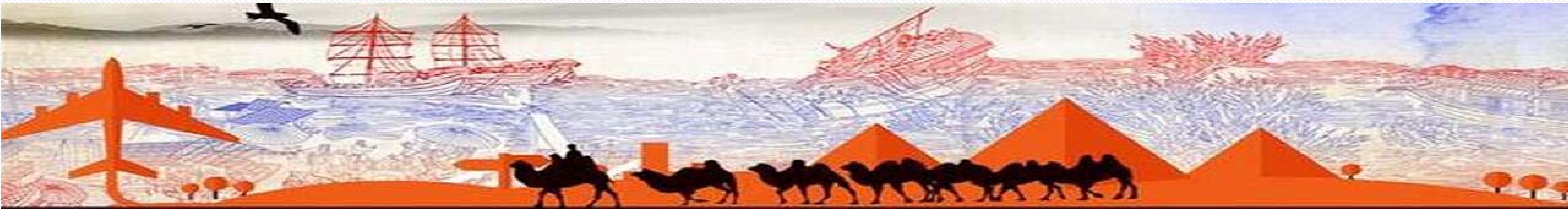

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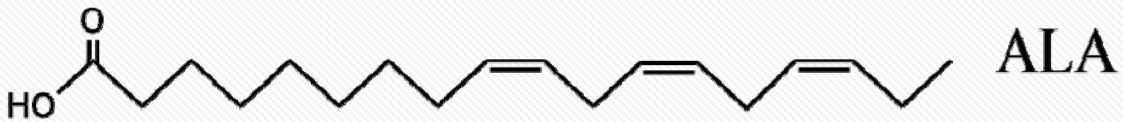
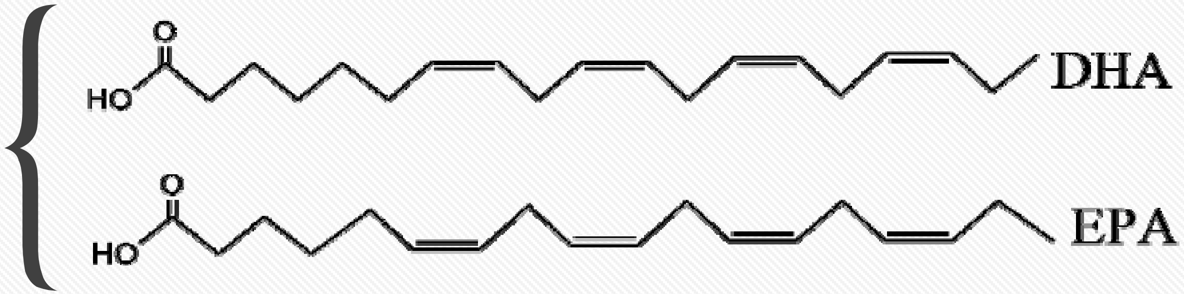
Background

α - linolenic acid



ω-3 polyunsaturated fatty acids



- An Essential Fatty Acid




[1] Roger M. Loria, David A. Padgett. Journal of Nutritional Biochemistry, 8(3), 140-146 (1997)

Background

Silkworm

Embroider

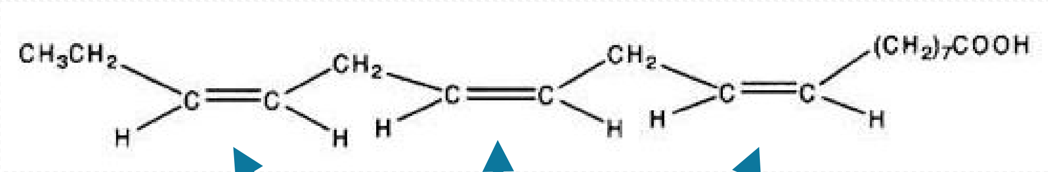
Silk

Silk Road

Silkworm pupae

0.5 Million tons/year

Previous study



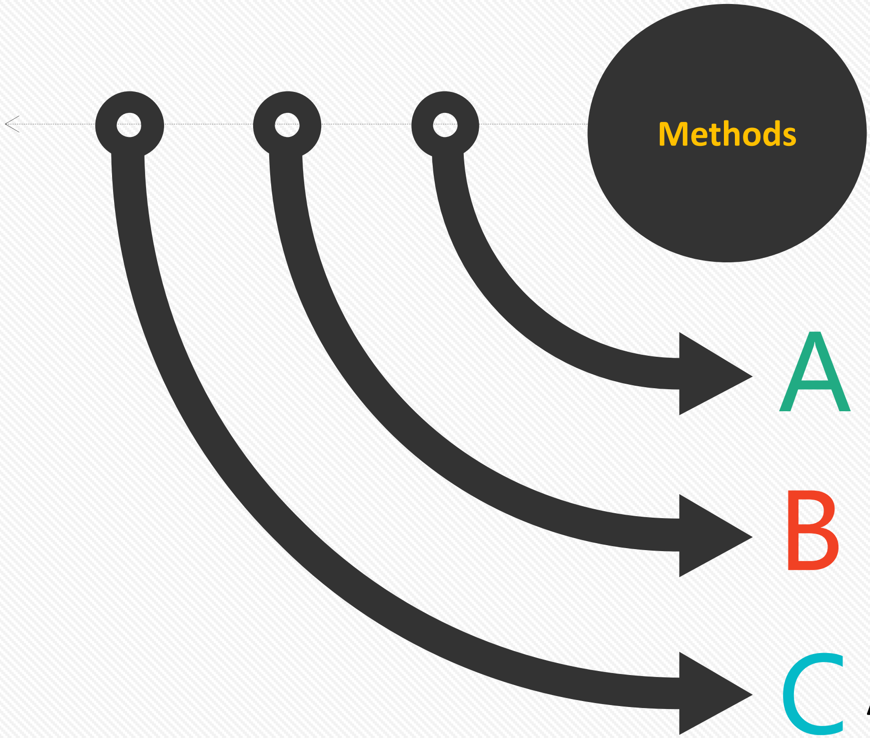
Three Double Bonds

Very Strong Reducibility

How to prevent to be oxidized ？

Easily to be oxidized

Effect of antioxidants on stability, nutritional values of refined sunflower oil during accelerated storage and thermal oxidation in frying



A NEW TECHNIQUE

A Oxygen absorbents

B Nitrogen filled protection

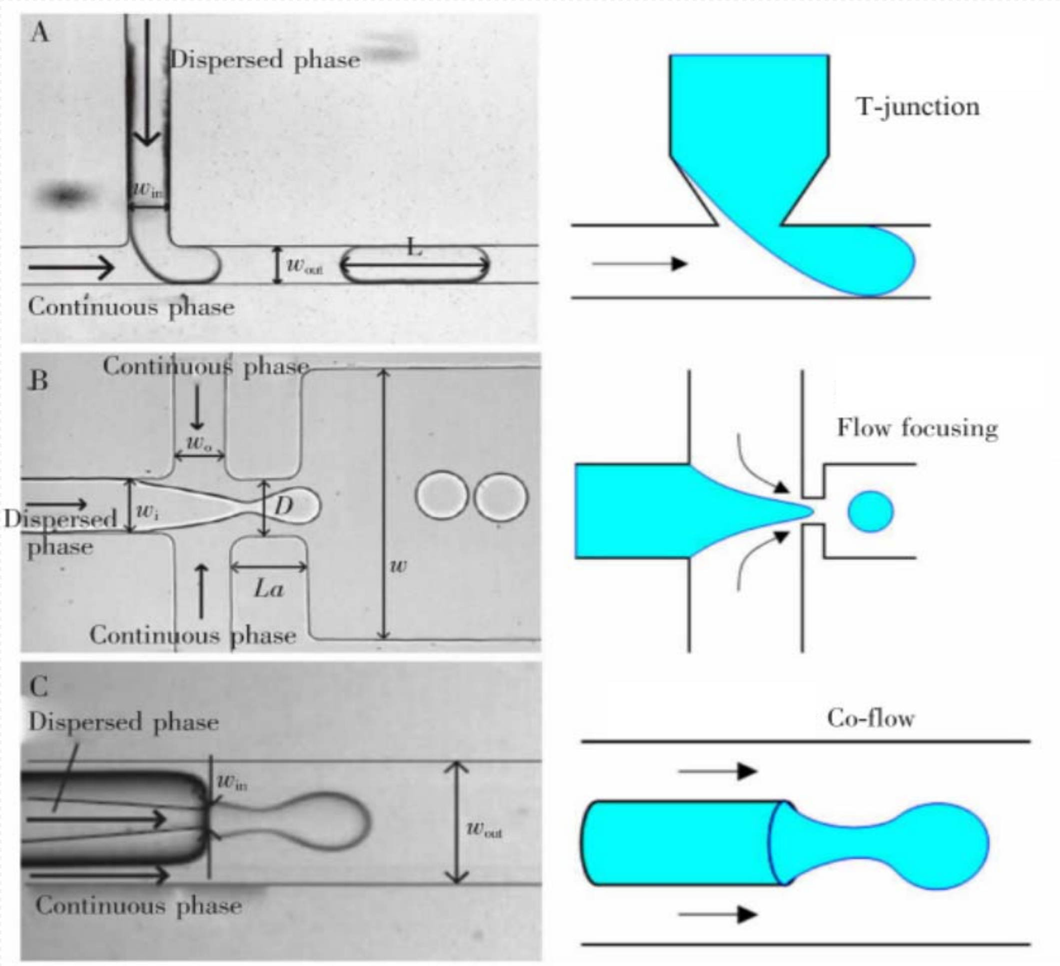
C Adding antioxidants into the oil

Drawbacks

Side effects of toxicity
Poor thermal stability

Dynamics of microfluidic droplets

Fig. 1. Three passive methods for generating microdroplets[3]



(A) T-junction microfluidic chip droplet formation method.
(B) Flow-focusing microfluidic chip droplet formation method.
(C) Co-flowing streams of microfluidic chip droplet formation method.

The right parts are schematic illustrations of relative Methods.

The colored area indicates the dispersed phase, and the arrow indicates the flow direction of the continuous phase.

[3] Baroud CN, Gallaire F, Dangla R. Lab on a Chip, 2010, 10(16):2032-2045.

Present study

Synthesis and characterization of caffeic acid grafted chitosan

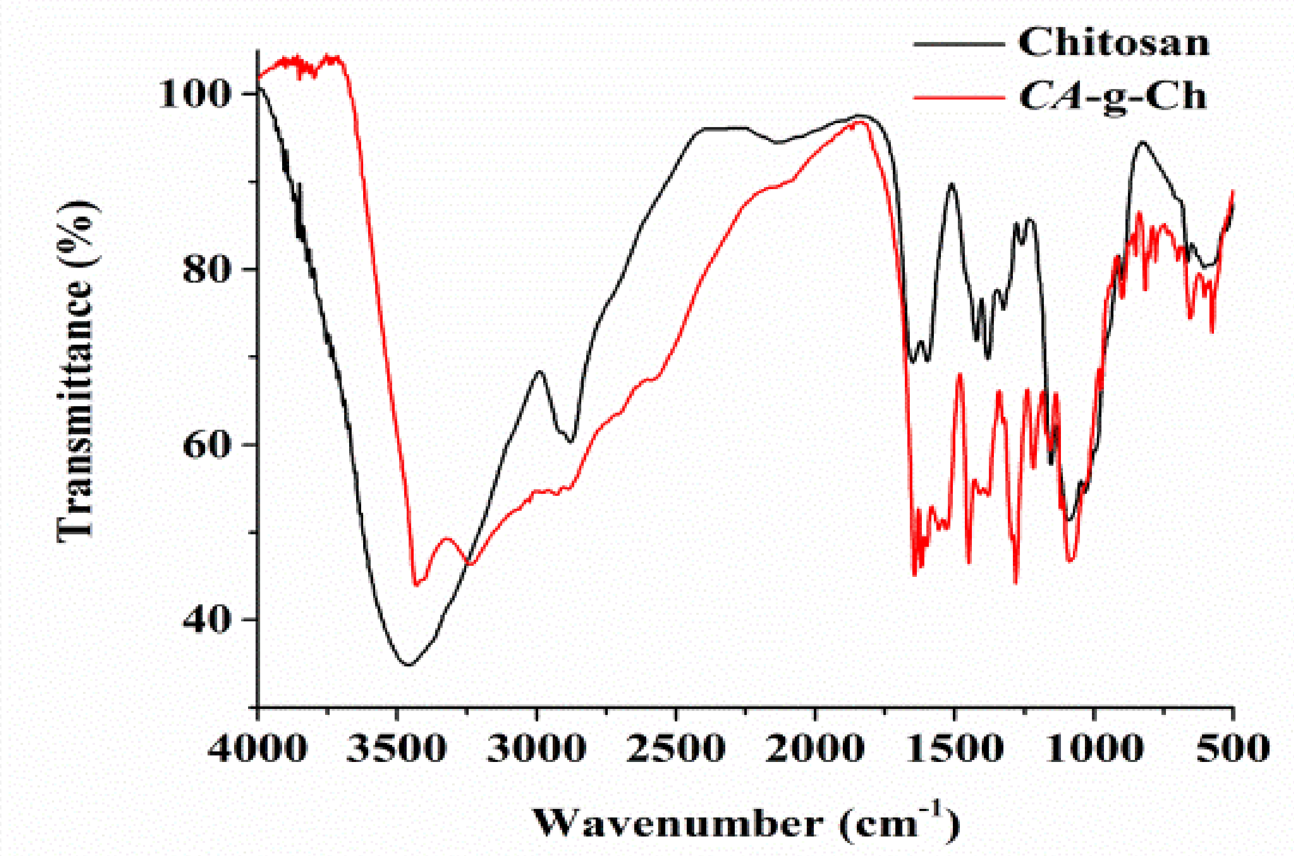


Fig. 2. FTIR spectra and structure assignment of chitosan and caffeic acid grafted chitosan

Effect of two-phase flow rate on droplet size

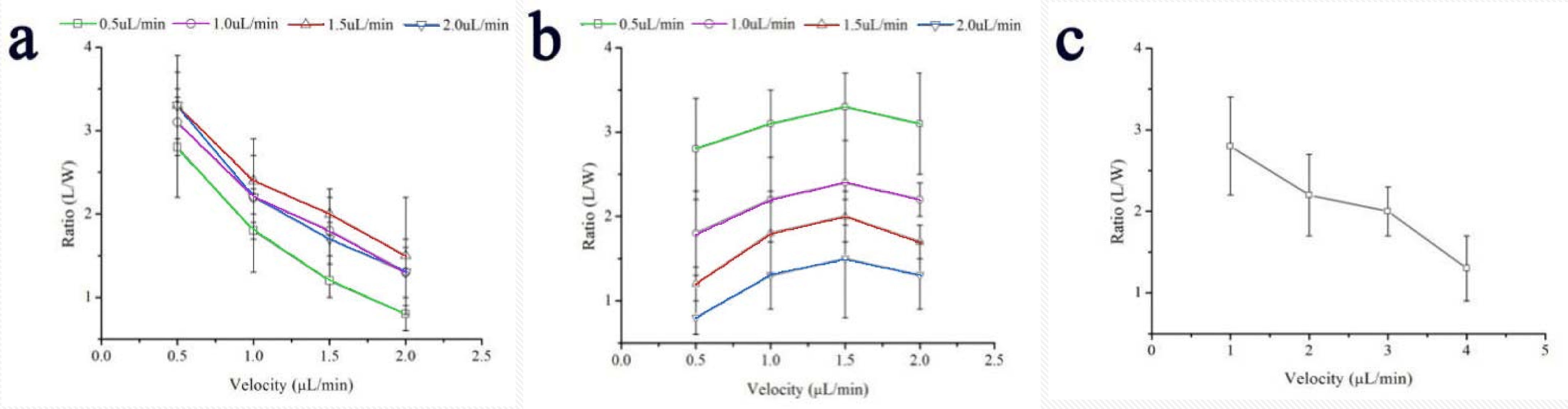
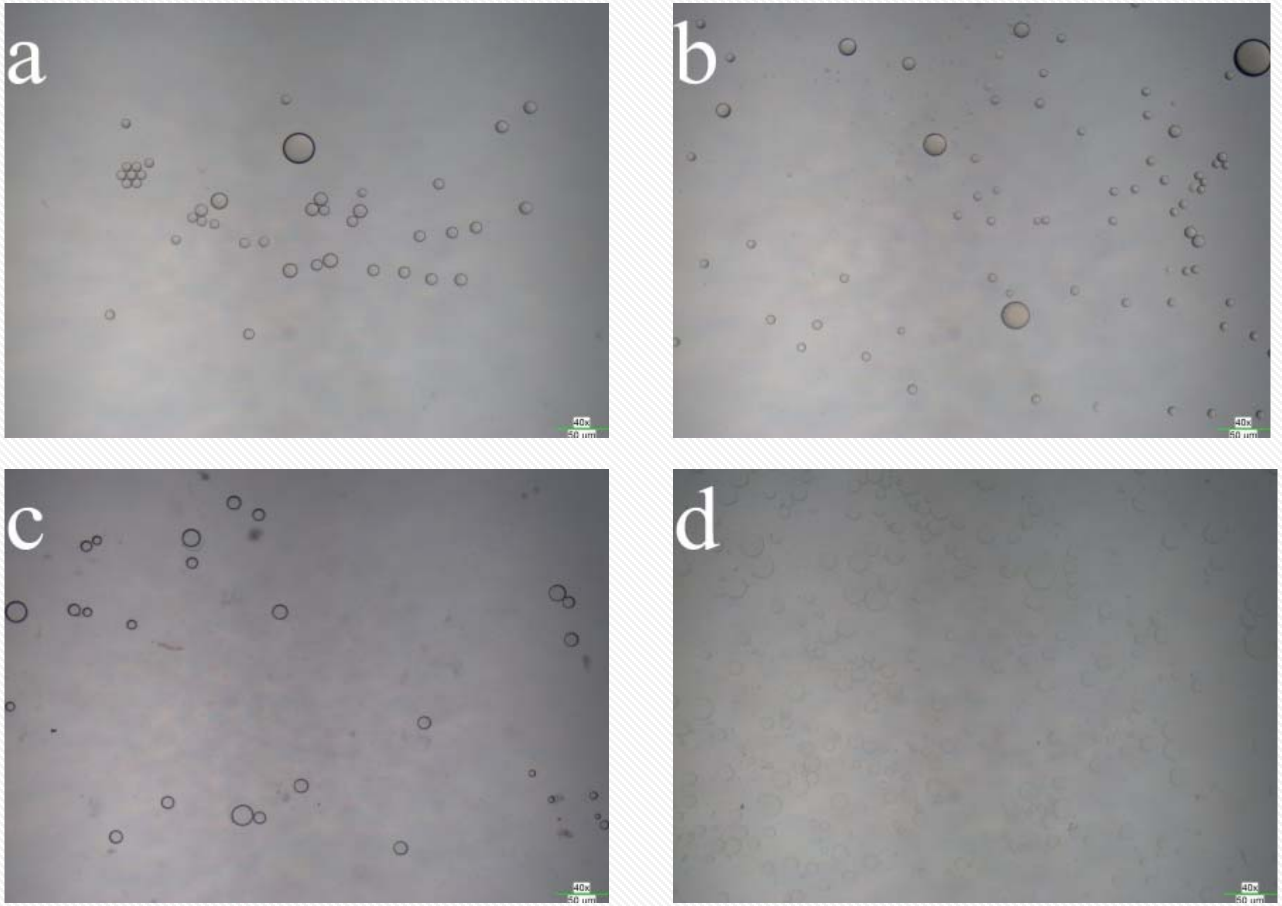


Fig. 3. The relationship between the formation of droplets and the two different phases.

(a) The relationship between continuous phase velocity and droplets size;
(b) The relationship between dispersed phase velocity and droplets size;
(c) The relationship between total velocity and droplets size.

Optimization of o/w emulsion process

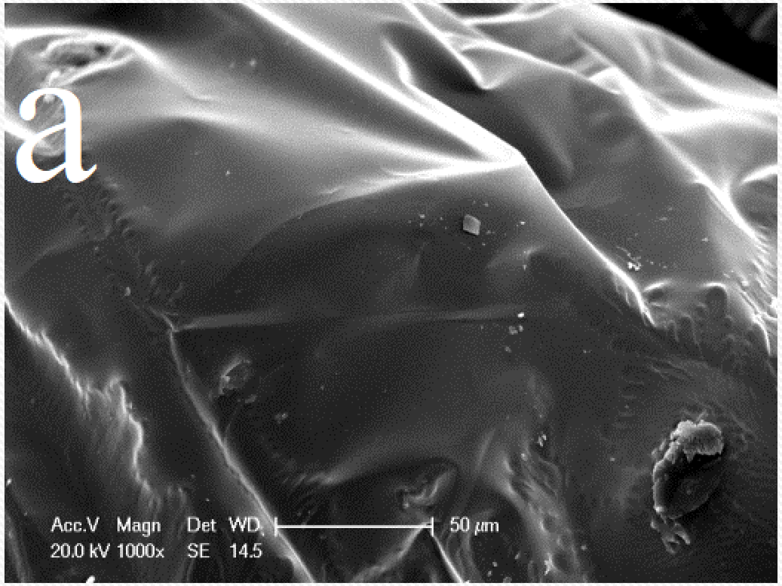
Continuous phase 0.75 μL/min
Disperse phase 0.45 μL/min



0.1% Tween 20

Fig. 4. Micrograph of emulsion containing Tween 20.
(a) 0.1% Tween 20; (b) 0.25% Tween 20; (c) 0.5% Tween 20; (d) 1.0% Tween 20.

Morphology and crystallinity of α - linolenic acid microcapsules



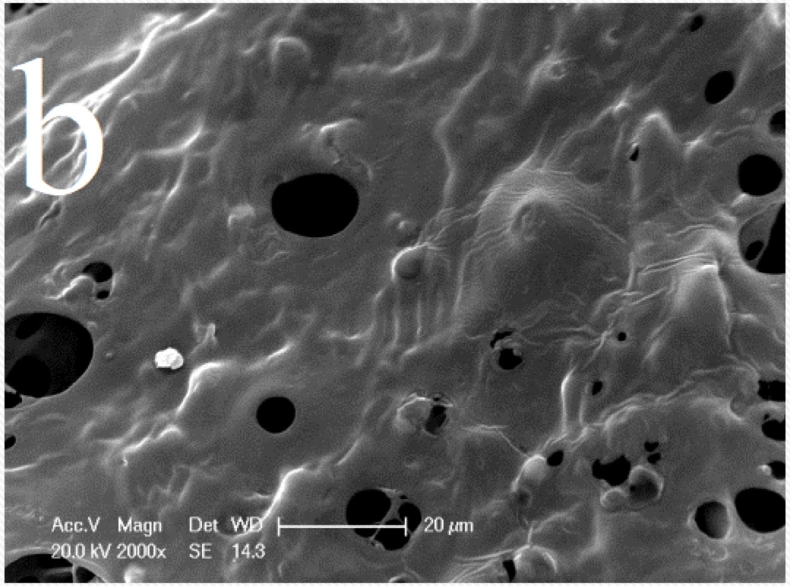


Fig. 5. SEM images of the α – linolenic acid microcapsules.
(a) Caffeic acid grafted chitosan at X1000; (b) α - linolenic acid microcapsules at X2000.

Morphology and crystallinity of α - linolenic acid microcapsules

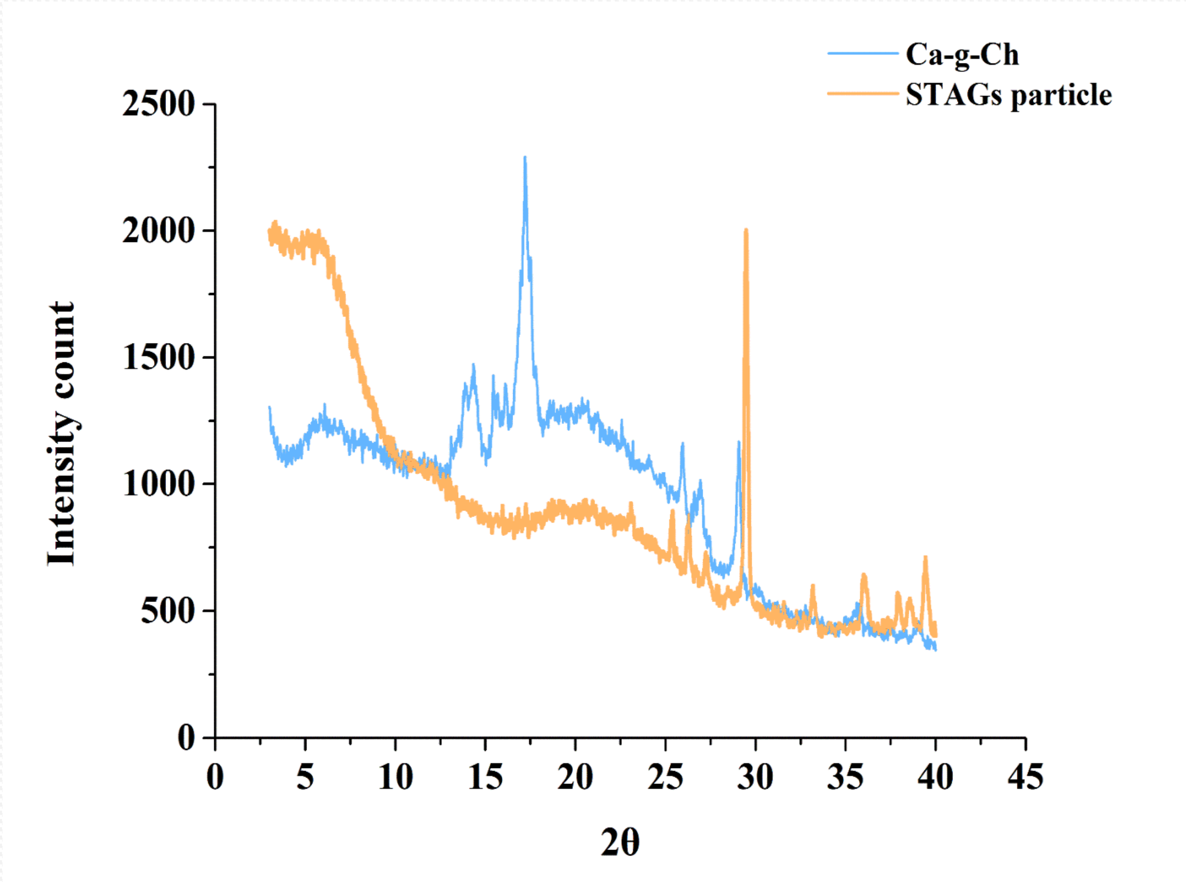


Fig. 6. X-ray defractograms of chitosan, caffeic acid grafted chitosan and α - linolenic acid encapsulate.

The TGA of α - linolenic acid microcapsules

25 °C to 800 °C

Sample		dual nt (%) 0 °C
ALA-M		82

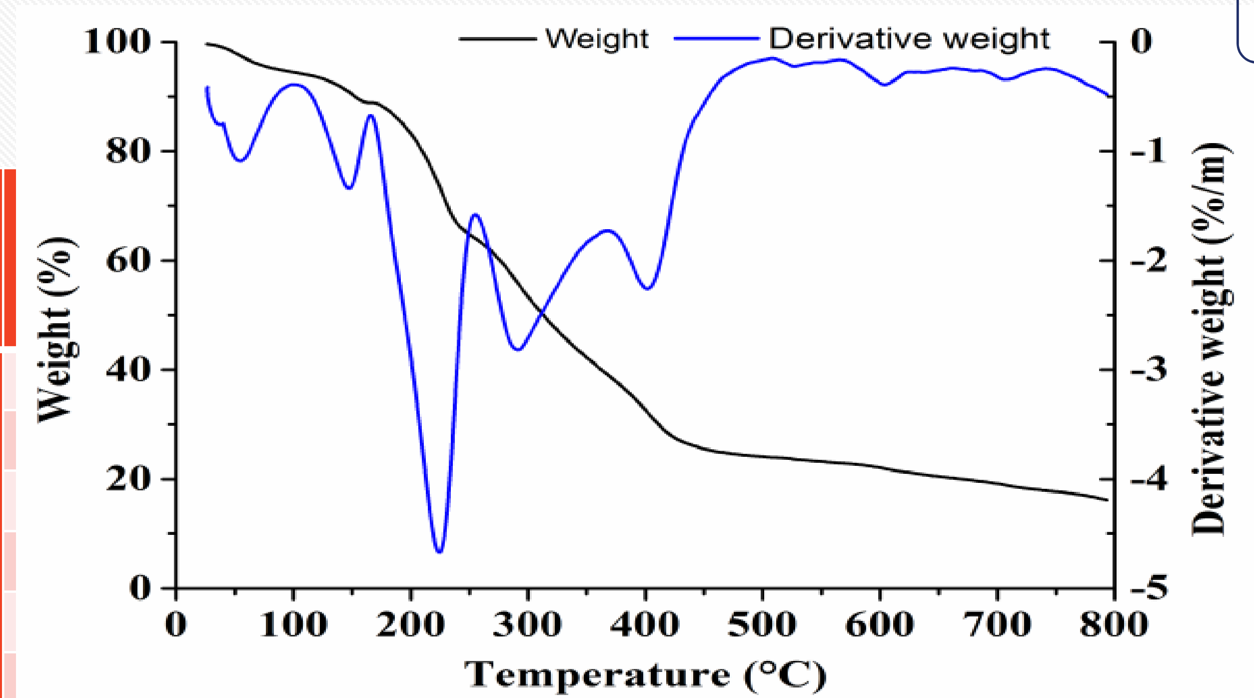
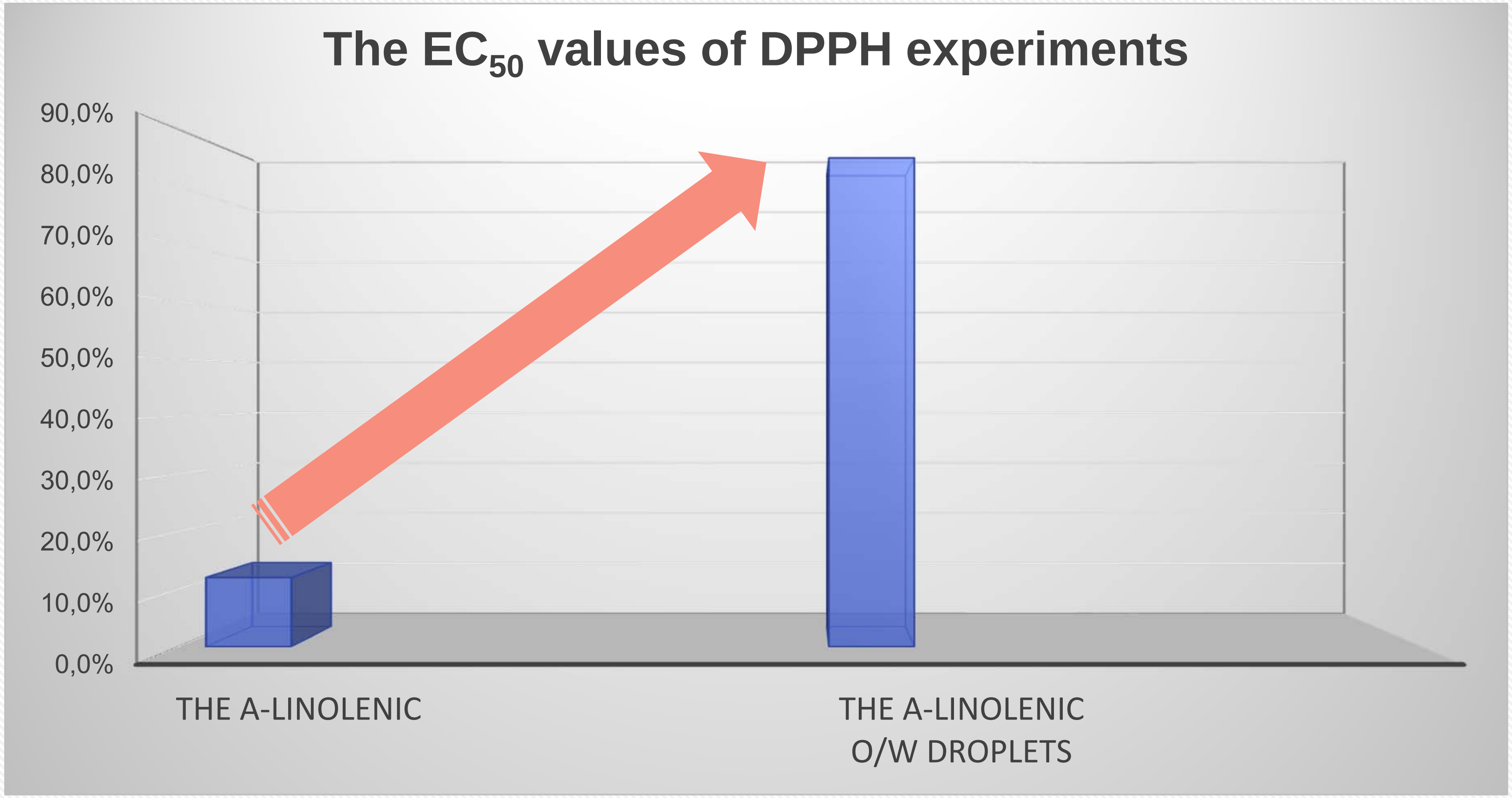


Fig. 7. The TG analysis of *α - linolenic acid microcapsules*

Antioxidant activity of α - linolenic acid microcapsules



Conclusions

1. The microfluidic droplet technique with anti-oxidation wall material was constructed to prepare monodisperse α - linolenic acid microcapsules.

2. The aqueous solution of caffeic acid grafted chitosan was used as the aqueous phase to prepare monodispersed droplets of α - linolenic acid by microfluidic droplet technology.

3. The 0.1 % Tween 20 solution was used to prepare O/W droplets with an encapsulation efficiency of 79%.

4. This capsule obtained after drying was uniform size, stable morphology, good rheological properties and high dispersion.

5. In addition, α - linolenic acid microcapsules showed excellent antioxidant properties (EC_{50} = 84.96±4.05%).

Acknowledgments

01

The Six Talent Peaks Project of Jiangsu Province (2015-NY-018)

The Qing Lan Project of Jiangsu Province (2014)

02

The Natural Science Research General Project of Jiangsu Province Universities (2017120206)

03

The Shen Lan Young scholars program of Jiangsu University of Science and Technology (2015)

04

The Key Research and Development Program (Modern Agriculture) of Jiangsu Province (BE2017322)

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Thank You Very Much For Your Attention！