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One step poly(quercetin) particle preparation as biocolloid and its characterization

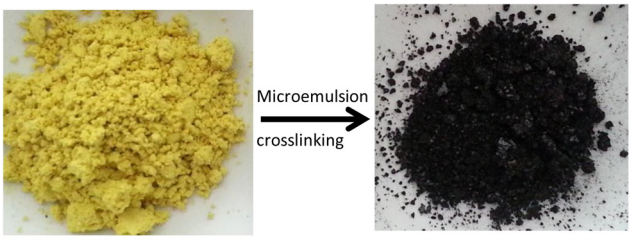
Nurettin Sahiner[a,b,*]

[a] Faculty of Science & Arts, Chemistry Department, Canakkale Onsekiz Mart University, Terzioglu Campus, 17100 Canakkale, Turkey
[b] Nanoscience and Technology Research and Application Center (NANORAC), Canakkale Onsekiz Mart University, Terzioglu Campus, 17100 Canakkale, Turkey

HIGHLIGHTS

- Highly negatively charged poly(quercetin) particles via microemulsion crosslinking.
- Antibacterial and antioxidant p(QC) particle with fluorescence properties.
- Natural biopolymeric microgels from a flavonoid, quercetin.

GRAPHICAL ABSTRACT



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ABSTRACT

Quercetin (QC) was reacted with glycerol diglycidyl ether (GDE) to obtain poly(quercetin) particles (p(QC)) for the first time via a simple microemulsion polymerization/crosslinking method using L-α lecithin as surfactant and cyclohexane as organic phase. The prepared p(QC) particles were highly negatively charged (−48.2 mV), were thermally more stable in comparison to QC and degradable in PBS at pH 7.4., e.g., 10 wt% can degrade in about 15 h. The prepared p(QC) particles showed antibacterial characteristics against common bacteria such as *Bacillus subtilis* ATCC 6633, *Escherichia coli* ATCC 8739 and *Staphylococcus aureus* ATCC 25323. Additionally, p(QC) was found to have significant antioxidant properties that is equivalent to 82.5 ± 9.6 mg/L gallic acid. More interestingly p(QC) particles retain some of their fluorescence and can be used both as antibacterial and antioxidant materials providing great potential for biomedical use.

1. Introduction

Quercetin (QC), as a flavonoid, is found in many plants including fruits, vegetables, leaves and grains. It has been reported that QC possesses numerous therapeutic properties including the ability to scavenge free radicals against oxidative stress and even to provide blood pressure reduction in people who have hypertension, in addition to many more health benefits. QC is an active anti-inflammatory with anti-cancer activity and has been extensively investigated in both in vitro and in vivo studies [1]. To increase the effectiveness and delivery of QC various methods have been developed due to the low solubility and bioavailability of QC, such as liposomal formulations [2], micelles derived from polymeric materials [3,4], polymeric films [5], microspheres [6], nanoparticles [7] and so on. The use of QC in the medical field for different purposes is steadily increasing. Interestingly, QC was found to be effective against oxidative stress and apoptosis and against neuronal damage from cerebral ischemia [8]. The other important

* Correspondence to: Faculty of Science & Arts, Chemistry Department, Canakkale Onsekiz Mart University, Terzioglu Campus, 17100 Canakkale, Turkey.
Tel.: +90 286 2180018x2041; fax: +90 286 2181948.
E-mail address: sahiner71@gmail.com

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biomedical use for QC is as anticarcinogenic and antioxidant [8–15]. Although there is only one report of enzymatic polymerization by QC [16], there are no reports on p(QC) and/or p(QC) particles. The enzymatic polymerization of QC was performed under normal conditions (1 atm, 25 °C) and a common enzyme, horseradish peroxidase (HRP), was used to catalyze to QC [16]. Although many biomedical benefits are inherently offered by QC as medicine itself, with antioxidant (radical scavenging ability), anti-bacterial

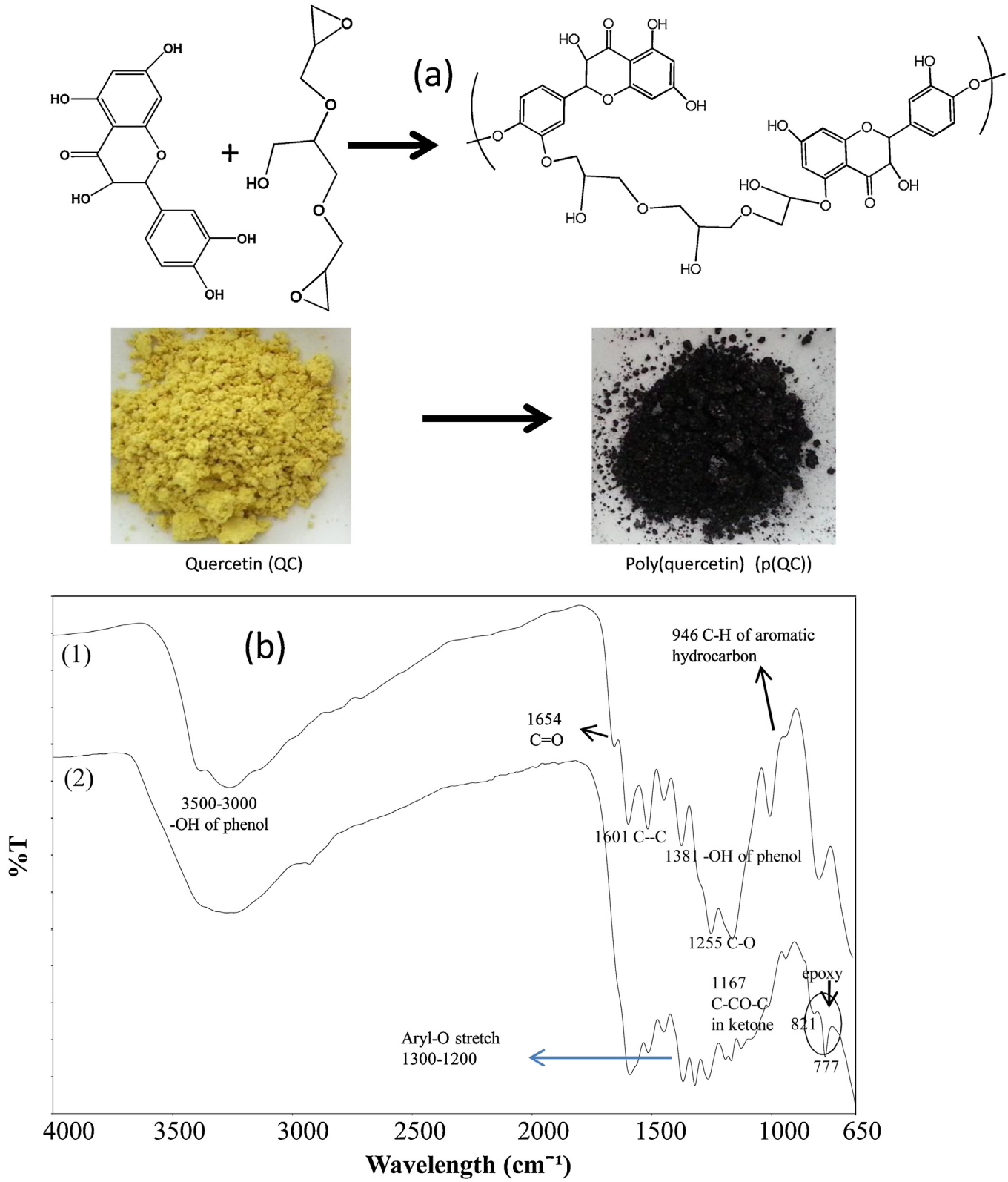

Fig. 1. (a) The schematic representation of the poly(quercetin) particle formation from quercetin and digital camera images. (b) FT-IR spectra of quercetin (1), and p(quercetin) particles (2) crosslinked with glycerol diglycidyl ether.