P3-16

Microencapsulation of Quercetin in Whey Protein concentrate by Spray Drying and Controlled Delivery Applications

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분무건조에 의한 quercetin의 Whey protein concentrate 미세캡슐화 및 방출조절

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실험목적 (Objectives)

- Quercetin, 3,3,4,5-7-pentahydroxy flavone is one of the most abundant flavonoid in medicinal plants. The antioxidant activity of this molecule is higher than well-known antioxidant molecules ascorbyl, trolox and rutin.
- In spite of this wide spectrum of pharmacological properties, the use of quercetin in pharmaceutical field is limited due to its low aqueous solubility and instability in physiological medium. These properties of quercetin result in poor bioavailability, poor permeability, instability and extensive first pass metabolism before reaching the systemic circulation
- One-way to circumvent these problems are to entrap/adsorb these molecule into hydrogel nanopaticle from natural and synthetic. Among the hydrogel microparticles, whey proteins have been reported to have excellent encapsulation properties and are superior to those of commonly used ingredients.
- Whey protein concentrate was shown to significantly improve perceived hair health, shine, hair loss, breakage, strength, length, growth rate, bounce, fullness and thickness for whom had experienced hair loss.
- 1) To microencapsulate quercetin as model anti-oxidants by spray drying methods; to compare protective effectiveness of encapsulation in terms of protection to anti-oxidant core. 2) To characterize the microcapsules produced by spray and freeze drying methods using scanning electron microscopy (SEM) and the quantification of encapsulation efficiency, antioxidant activity and in vitro release was also carried to enhance its application in pharmaceutical field. 3) To investigate effect of whey protein concentrate in protection and strengthening for the hair with with a fluorescent substance (fluorescein isothiocyanate - FITC) labeling.

재료 및 방법 (Materials and Methods)

1. Materials

Corematerial : quercetin(>95%, Sigma-Aldrich, Steinheim, Germany)

Wall material : Whey protein concentrate (WPC, Davisco International Inc., Eden Prairie, MN, USA)

2. Encapsulation of quercetin hydrate : WPC concentrations (pH 7.4, phosphate buffered saline) → Agitating (2,000 rpm, 1 h) → Add for encapsulation (different

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mass ratio of quercetin to wall materials, 1:20, 1:30, 1:40) → Agitating (2,000 rpm, 2 h) → Homogenization (10,000 rpm, 15 min) → Spray dryer(Flow rate 5 mL/min, drying chamber 180 and 85℃) → Desiccator Store

3. Scanning electron microscopy : Microencapsulated quercetin powders morphological features : Scanning electron microscopy (SEM)

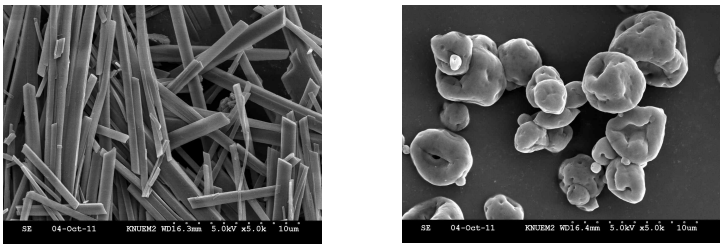
4. Sectroscopic characteristics : UV-VIS spectrophotometer (220-700nm)

5. Encapsulation efficiency : DPPH free radical scavenging activity

6. Effect of whey protein in protection and strengthening for the hair : WPC labeled with a fluorescent substance (fluorescein isothiocyanate - FITC) - observe by fluorescence microscopy / Induction of hair tress : beaching (3 time) → Robotic combing machine (50 time) → bending stability test

실험결과 (Results)

The quercetin has been encapsulated on whey protein concentrate (WPC) microparticles by spray drying method for the improvement of its poor aqueous solubility and stability. The antioxidant activities of the WPC encapsulated quercetin micromedicine are identical to free quercetin. The microencapsulation efficiency of quercetin evaluated by antioxidant assay is 38.0%. The in vitro release kinetics under physiological condition show initial burst release followed by slow and sustained release. The complete release and maximum retention of quercetin is 1:20 in different mass ratio of quercetin to wall materials at 12 h. These properties of WPC encapsulated quercetin molecule pave way for encapsulating various therapeutically less useful highly active antioxidant molecules towards the development of better therapeutic compounds. WPC can be used to achieve an intelligent repair and strengthen effect of hair an bending stability of up to 75% in the hair loss by hair tress, also it penetrate deep into the hair.



A B

Fig 1. SEM image of (A) quercetin and (B) whey protein encapsulated quercetin using spray drying

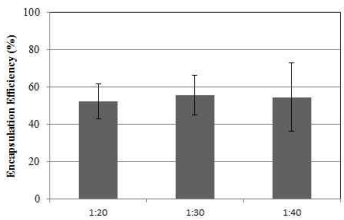


Fig 2. Encapsulation efficiency in different mass ratio of quercetin to wall materials (1:20; 1:30: 1:40)

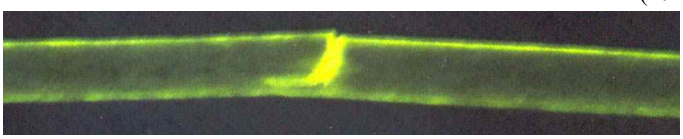


Fig 3. Fluorescence microscope image of the hair after treatment with wey protein.