THE PREPARATION AND CHARACTERIZATION OF MICROPARTICLES BASED ON WHEY PROTEIN ISOLATE

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Introduction

Whey protein isolate (WPI) is a by-product of the dairy industry obtained during the industrial production of cheese or casein. It consists of a mixture of globular proteins, mainly β-lactoglobulin and α-lactoglobulin. Due to its excellent gelling, film-forming and emulsifying properties, WPI is widely used in various food products. Recent studies show that WPI can also be a matrix for encapsulation of biologically active compounds. Many techniques have been developed for the production of protein-based microparticles including spray drying, coacervation or emulsion-crosslinking method [1-5]. However, these methods require heating or using organic solvents in at least one stage of production, which can negatively affect encapsulated active ingredients. For this reason, there is a need to develop a method for preparing WPI-based microparticles, which allow protection and stability of the incorporated substance.

The aim of this work was to prepare and characterize microparticles based on whey protein isolate and sodium alginate containing *Calendula officinalis* flower extract.

Materials and Methods

In order to obtain WPI-based microparticles, aqueous solutions of whey protein isolate and sodium alginate (ALG) were mixed with *Calendula officinalis* flower extract and transferred to the encapsulator's pressure bottle. A large flat beaker filled with 2% (w/v) calcium chloride solution was placed under a nozzle on a magnetic stirrer. The diameter of the nozzle, as well as parameters of the encapsulator (pressure, liquid flow, vibration frequency and electrostatic voltage) were set to obtain the correct microparticle chain in the light of a stroboscope lamp.

Composition of microparticles:

- 4% (w/v) WPI aqueous solution + 0.5% (w/v) ALG aqueous solution + 0.5% *Calendula officinalis* flower extract → **WPI 4% ALG 0.5%**
- 4% (w/v) WPI aqueous solution + 1% (w/v) ALG aqueous solution + 0.5% *Calendula officinalis* flower extract → **WPI 4% ALG 1%**
- 5% (w/v) WPI aqueous solution + 0.5% (w/v) ALG aqueous solution + 0.5% *Calendula officinalis* flower extract → **WPI 5% ALG 0.5%**
- 5% (w/v) WPI aqueous solution + 1% (w/v) ALG aqueous solution + 0.5% *Calendula officinalis* flower extract → **WPI 5% ALG 1%**

The morphology and size of obtained microparticles were determined using a stereo microscope Motic SMZ-171 BLED. Swelling properties was measured by weighing the wet microparticles and after drying for 24h at room temperature. Loading capacity of active substance was performed using UV/Vis spectrophotometric method.

Results and Discussion

Microparticles based on WPI and sodium alginate have regular, spherical shape and rough surface (FIG. 1). The prepared microparticles are homogeneous and have very similar dimensions - the standard deviation of their average size is less than 2.8% of the particle size. Their diameters after drying have significantly decreased. The largest difference in their sizes before and after drying was observed for microparticles consisting of 5% WPI and 0.5% ALG (2339±56 μm and 982±16 μm, respectively). WPI-based microparticles have a high swelling ability ranging between 670–830%. The lowest swelling degree was observed for WPI 4% ALG 1% microparticles, while the greatest swelling capacity have WPI 5% ALG 0.5% microparticles. Similar dependencies were also observed for loading capacity. The lowest amount of *Calendula officinalis* flower extract was loaded into WPI 4% ALG 1% microparticles (approx 170 mg/g). The most effective incorporation of extract was noted for microparticles composed of WPI 5% ALG 0.5% (approx 290 mg/g).

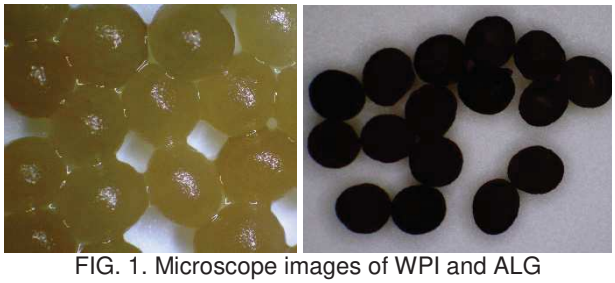

FIG. 1. Microscope images of WPI and ALG microparticles containing active substance: A) swollen microparticles, B) dry microparticles.

Conclusions

The obtained spherical microparticles based on whey protein isolate and sodium alginate have successfully incorporated *Calendula officinalis* flower extract. Higher WPI concentration and lower sodium alginate content contributed to the incorporation of a higher amount of *Calendula officinalis* flower extract into the microparticles. Due to biodegradability and occurrence in nature of WPI and sodium alginate, the developed microparticles may be the basis for obtaining a new class of materials for cosmetic, dermatological, pharmaceutical and biomedical purposes.

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