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Preparation and Optimization of Physical and Chemical Properties of Chu Shizi Flavone Microcapsules

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Abstract: Chusizi has a long history as a traditional Chinese medicine, with clear effects, rich resources and low raw material price, which is suitable for large-scale production. In order to achieve protection and controlled release, microencapsulation technology is introduced to bury the small dispersed and reactive core wood flavone extract with natural or synthetic wall material. The bitterness of microencapsulated drugs is greatly reduced, and compared with ordinary drugs, microencapsulated drugs can reduce their own toxic and side effects, improve stability and reduce the amount of drugs. At the same concentration, the cytotoxicity of the drug after microencapsulation is significantly reduced, indicating that microencapsulation has a slow release effect on the drug and can improve the drug efficacy, so the Chu seed after microencapsulation is more beneficial to human body.

1. Overview

"Combination of medicine and industry" is the need of the development of modern medicine. Polymer materials are widely used in the field of biomedicine. This project mainly explores the embedding of Chushizi flavone with microencapsulation technology, so as to protect the nutrients of Chushizi flavone and improve its stability.

2. Preparation of Chu Shi Zi microcapsules

In order to improve the stability and bioavailability of flavone fructifolia, microcapsules of flavone fructifolia were prepared by spray drying using carrageenan + modified starch, gumarabic (GA)+ modified starch, maltodextrinMD + modified starch + gelatin as wall materials [1]

2.1 Materials and Reagents

fructifolia, Rutin standard (>98%), pepsin (enzyme activity 3000U/ pancreatic enzyme (enzyme activity 300000U/g) Beijing Solaibao Technology Co., LTD.; Carrageenan, acacia gum, maltodextrin, modified starch, gelatin, all food grade, Shandong Wenxing Biotechnology Co., LTD.; Sodium hydroxide, Sodium nitrite, anhydrous ethanol, Sodium dihydrogen phosphate, aluminum nitrate, disodium phosphate Shanghai Runjie Chemical Reagent Co., LTD., potassium bromide Tianjin Zhiyuan Chemical Reagent Co., LTD. :(1, 1-DiPhenyl -2-picrylhydrazylDPPH) Shanghai Maclin

Biochemical Technology Co., LTD., ATBS kit Beijing Ehuamao Biotechnology Co., LTD., the above reagents are analytically pure, the experimental water is ultra-pure water. Fourier transforminfrared spectroscopy, Shanghai Precision Scientific Instruments Co., LTD. :B-290 spray dryer Switzerland BUCHL company :UV-6000 UV-visible spectrophotometer Shanghai Yuan Analysis Instrument Co., LTD. :HHS digital display constant temperature water bath Shanghai Boxun Industrial Co., LTD. Medical equipment factory; Scanning electron Microscope Tesken Trading (Shanghai) Co., LTD. British Malvern Instrument Co., LTD. :G-040s ultrasonic cleaning machine Shenzhen Geoneng Cleaning Equipment Co., LTD

2.2 Preparation method

On the basis of the previous experiment, the types of wall materials were carrageenan 4 modified starch (mass ratio of 2), GA+ modified starch (mass ratio of 2:1), MD+ modified starch 4 gelatin (mass ratio of 2:1:1), the mass ratio of core material to wall material was 1:5, and the flavonoids of unembedded Tartary buckwheat sprouts were used as the control group. To investigate the effect of different kinds of wood on the embedding effect of Chu Shi Zi flavonoid microcapsules [2-3].

Accurately weigh a certain amount of wall material into 60℃ distilled water dissolved into suspension (w/v5%), adding Chu seed

Flavone-like solution was homogenized for 10 min and spray drying was carried out to obtain Chu Shi Zi flavonoid microcapsules under spray drying conditions. The inlet air temperature was 180℃, the outlet temperature was 110℃, the peristaltic pump speed was 10r/min, and the feed speed was 15mL/min. The prepared microcapsules were stored in the dryer.

2.3 Determination of total flavone content

The content of total flavonoids was determined by colorimetric method of aluminum nitrate and sodium nitrite. Rutin was prepared into 0.20mg/mL standard solution, and 0.0, 0.2, 0.4, 0.6, 0.8, 1.0, 2.0 and 3.0mL were removed into a 10mL volume bottle, and 0.3mL of 4% NaNO2 solution was added, shaken well and left for 6min. Add 0.3mL of 10% Al (NO3) 3 solution, shake well and let stand for 6min, then add 4.0mL of 5% NaOH solution, use 70% ethanol to fix volume, shake well and let stand for 15min. Using no standard material as blank, the absorbance value was measured at 510nm, and the absorbance (A) versus rutin concentration (C) was used to draw A standard curve, and the regression equation A=0.0035C+0.0022 (R2 =0.9994) was obtained. The absorbance value of the sample was determined by the same method, the flavonoid concentration was calculated according to the regression equation, and the total flavonoid content of the sample was calculated according to formula (1)

$$X=\frac{Y\times V_1}{C\times V_2}\times 1000 \tag{1}$$

2.4 Determination of microencapsulation rate

According to the method, as the wall material of microcapsules is water-soluble and the core material is alcohol-soluble, 50% ethanol is selected as the solvent. 1.0000g flavonoids microcapsules were accurately weighed and added into 50% ethanol, dissolved by ultrasound for 30min, and the supernatant was filtered to 25mL. Flavonoid content was determined and calculated, and the total flavonoid content of M-LBF was A (1mg). Using anhydrous ethanol as solvent (the same method as above), the flavonoid content was determined, namely, the surface flavonoid content A0 (mg) of M-LBF was obtained.

The influences of embedding rate, moisture content, packing density, Angle of repose and hygroscopicity of microcapsules are shown in Table 1.

β-cyclodextrin was used as wall material to prepare the product, and the embedding rate was 80.65%. Compared with the control group, the water content in the microcapsules after the wall material embedding was reduced, indicating that the water of the microcapsules embedded by the wall material was fully evaporated during the spray drying process, which was conducive to the long-term storage of the microcapsules. After β-cyclodextrin encapsulation, the flavonoids accumulation density of fructus broussonetia broussonetia was higher, indicating that it can be stored in a smaller capacity, which is beneficial to reduce the amount of air in the powder voids and prevent microcapsule oxidation. The repose Angle of microcapsules obtained by the experiment is less than 45 °, indicating that the viscosity of the product is small and the fluidity is good[4-5].

Table 1: Influence of environmental factors on Chu Shizi microcapsules

	Embedding rate (%)	Moisture content (%)	Packing density (g/cm^3)	Angle of reactivity (°)	hygroscopicity (%)
Control group	/	6.58±0.15	0.23±0.02	24.31±1.01	72.24±3.76
Experimental group	80.65±2.51	6.12±0.13	0.38±0.01	37.65±0.86	42.08±3.99

Hygroscopicity, as an important index to evaluate product stability, will affect powder storage stability and shelf life. Would disappear real flavonoids as control group, the disappear of microcapsules flavonoids as experimental group, the table 1 shows that compared with 0 d, 7 d after storage, the hygroscopicity of the control group significantly increased, up to 62.14% ($P < 0.05$), and the embedding of microcapsule hygroscopicity haven't changed much, were less than 50%, prove the embedding is beneficial to product storage stability, Extend the shelf life.

The results showed that spray drying Tartary buckwheat sprout flavonoids microcapsules had stable performance and good antioxidant activity in vitro.

As shown in the figure 1, when the mass concentration of flavonoids is within the range of 200-1000 ug/mL, there is a positive correlation between the DPPH free radical scavenging ability and the mass concentration of flavonoids. In the control group, the DPPH free radical scavenging ability of Broussonetia Broussonetia microcapsules is enhanced with the increase of the mass concentration of flavonoids, indicating that the antioxidant capacity is also enhanced. At the same concentration of flavonoids, the DPPH radical scavenging ability of the microcapsules embedded with wall wood was higher than that of the control group without wall wood embedding, but it was less than 80%. This may be because the microcapsules embedded with wall wood had a larger surface area in the reaction system and were in contact with DPPH free radicals.

As one of the important bioactive substances in fructus Broussonetia Broussonetia, flavonoids are mainly metabolized by a large number of intestinal bacteria. Biotransformation after intestinal release can improve the antioxidant level in the intestine. Therefore, it is necessary to avoid the destruction of flavonoids by gastric juice as much as possible, and finally be fully absorbed and utilized by the intestine. The release rate of fructus broussonetia broussonetia microcapsules in vitro simulated digestion slow release process is shown in the figure 2. As can be seen from the figure 2, in the 0-4 h simulated gastric juice stage, the flavonoids release rate of microcapsules increased slowly with the increase of time, and the final flavonoids release rate in gastric juice was 9.14% successively. At 4-10 h intestinal fluid digestion stage, the flavonoids release rate of microcapsules increased rapidly with the increase of time. At the end of intestinal digestion stage, the flavonoids release rate of microcapsules was higher than 80%, indicating that the intestinal digestion stage was more conducive to the release of the core material of microcapsules, possibly because the wall material would shrink under acidic environment, and the microcapsule capsule.

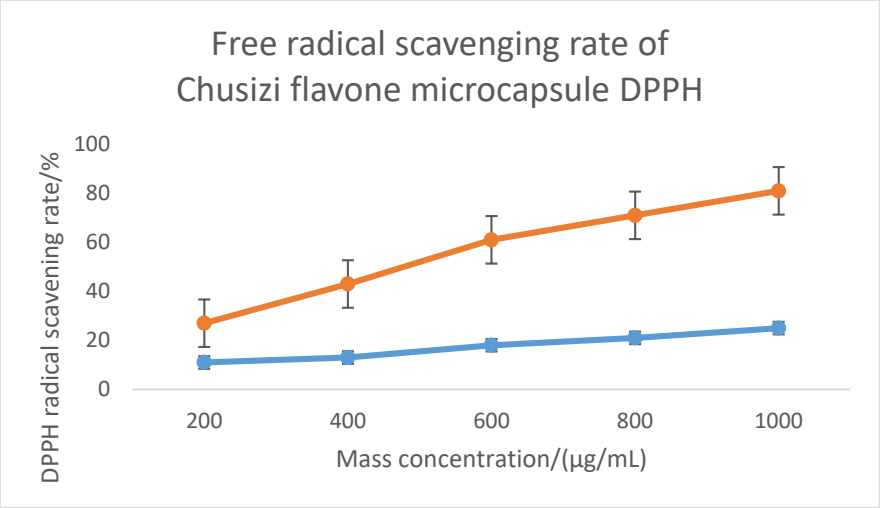

Figure 1: Free radical scavenging rate of Chusizi flavone microcapsuke DPPH

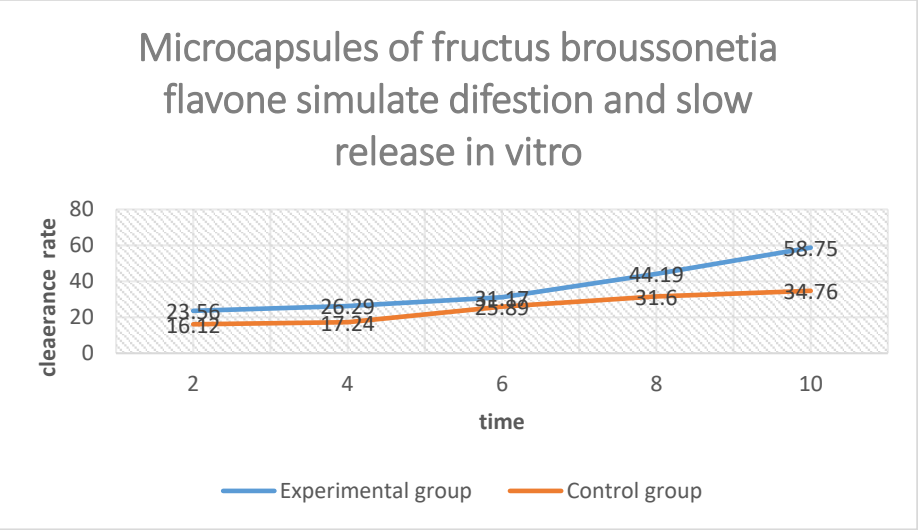

Figure 2: Slow and controlled release effect of Chu Shizi microcapsules

The wall gradually degrades and the active substances of the core material are protected. However, when entering the neutral and alkaline environment, the cyst wall will swell and degrade due to water absorption, and the barriers limiting the release rate of the core material gradually disappear, which is caused by the rapid release of the core material[6].

3. Summary and pros pect

Chushizi as a traditional Chinese medicine has a long history, clear effect, rich resources, low raw material price, suitable for large-scale production. In order to achieve protection and controlled release, microencapsulation technology is introduced to bury the small dispersed and reactive core wood flavone extract with natural or synthetic wall material. The bitterness of microencapsulated drugs is greatly reduced, and compared with ordinary drugs, microencapsulated drugs can reduce their own toxic and side effects, improve stability and reduce the amount of drugs. At the same concentration, the cytotoxicity of the drug after microencapsulation is significantly reduced, indicating that microencapsulation has a slow release effect on the drug and can improve the drug efficacy, so the Chu seed after microencapsulation is more beneficial to human body. Therefore, the

purpose of this project is to explore the protective effect of Chushizi microcapsules on chemical liver injury, lay a foundation for further research on the pharmacological mechanism of Chushizi microcapsules, and also contribute to the modernization of traditional Chinese medicine. Student Innovation and Entrepreneurship Plan Project (R2022094).

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