

# HYDROGEL-BASED MATERIALS FOR DELIVERY MEDICINAL PLANT EXTRACTS – PRELIMINARY STUDIES

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## Introduction

*Calendula officinalis* (pot marigold) is one of the major medicinal plants. The phytopharmacological studies of marigold flower extract confirm its anti-inflammatory and antiviral activity as well as antimicrobial properties. Therefore, the flower extract of this plant has been used for the treatment of burns, ulcers, skin inflammations, eczema, and wounds [1,2].

The pharmacological activity of *Calendula officinalis* flower extract could be enhanced by its encapsulation that controls the release of active compounds over time. Encapsulation technology is used for improving the long-term stability of active substances and enhancing and prolonging the effectiveness of active ingredients [3].

The main goal of this study was to design, prepare and characterize novel hydrogel materials with plant extract-loaded microcapsules incorporated into hydrogel structure. The skin reaction was examined after application of the obtained hydrogel.

This solution in the design of hydrogel materials may become the basis for a new dermatological formulation.

## Materials and Methods

The microspheres were produced from gelatin [4]. Hydrogels were made from 2% carrageenan solution [5] with the addition of fish collagen [6]. To prepare microcapsule-loaded matrices, gelatin microspheres with pot marigold flower extract were mixed with carrageenan/collagen solution and magnetically stirred for 30 min. Then, 10 ml of each mixture was poured into Petri dishes. Finally, hydrogels were immersed in 1 M solution of potassium chloride at the temperature of 2°C for 24 hours.

The skin color after application of obtained hydrogel was examined using the colorimeter (Skin-Colorimeter CL 400, Courage + Khazaka, Köln, Germany) with the use of MPA-software. The influence of the hydrogel on the skin was determined before application, immediately after application and 15, 30, 60, 120 and 180 min after application of the samples. The skin parameters measurements were conducted on the volar forearm skin with participation of five probands with normal skin (women, aged 23–29) after written consent, in the laboratory in controlled temperature and humidity.

## Results and Discussion

The measured skin color is expressed as an XYZ-value and was calculated into  $L^*a^*b$  related value.  $L^*$  gives information about the black-white axis and skin brightness, while  $a^*$  and  $b^*$  are the coordinates in the color space— $a^*$  locates the values on the red-green axis, whereas  $b^*$  shows the color position on the blue-yellow axis. Therefore, the  $a^*$  values were considered in this research due to their correlation to skin redness, erythema, and microcirculation. Skin color results suggest that the application of carrageenan/collagen-based hydrogels with incorporated microcapsules did not damage, irritate skin, or cause erythema (skin redness).

## Conclusions

The preliminary studies confirm that the obtained hydrogels are safe for the skin, they do not cause its irritation. Further studies will be devoted to assessing the parameters of *Calendula officinalis* flower extract release from microcapsules incorporated into carrageenan/collagen hydrogel.

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