

Carotenoids skin availability - the stripping proof

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SCIENCE & RESEARCH

Carotenoids are the one's of the antioxidants used in the modern cosmetology. Their bioavailability for a long time was out of concern because of the appropriate lipophilicity and moderate molecular weight. Probably it was a reason of lack of more systematic investigations on the carotenoid transepidermal transport.

The aim of our study was to explain a phenomenon of skin staining with yellow-coloured carotenoids. Unexpectedly we found that carotenoids-related skin staining is highly dose-dependent but only temporal, simple solutions of surfactants were able to clean even strongly stained skin surface. It seemed to be illogical on account of lipophilicity of carotenoids and its possible good solubility in the stratum corneum intercellular cement.

For the experimental research on the bioavailability of carotenoids and the s.c. penetration pattern in in vivo conditions a method of the stripping was chosen. This technique is universally used in investigations of the permeation of substance through the epidermis, mainly of drugs, sunscreens, fungicides and of dyes. However it weren't used so far to carrying out research on the bioavailability of carotenoids. Using this technique in case of the research on the permeation of carotenoids seems promising on account of its noninvasiveness and the low time consumption as well as a no necessity to use specialist apparatus. A possibility of the spectrophotometric detection of examined compounds in strips was an additional asset of choice of this technique.

The stripping was conducted on the group five volunteers in the age of 23-24 years. None of volunteers for 4 weeks before the examination and in the course of it didn't take orally carotenoid-containing preparations. Carotenoid (beta-carotene, BC) was extracted from every stripping tape by 10 ml of acetone through 15 min. Collected extract were filtered through paper filters and they were analyzed spectrophotometrically at 455nm wavelength. Beta-carotene 30% FS was obtained from DSM Nutritional Products Ltd.

Based on results of the preliminary investigations on the BC solubility in emollients, for further research we chose two emollients as vehicles for BC topical application: decyl oleate and mineral oil (Paraffinum Liquidum). We chose decyl oleate as a vehicle since BC shows the very good solubility in it. For comparison we chose an emollient of opposite physicochemical properties but good BC solubility: mineral oil which forms the occlusive layer on the surface of the skin.

We found that BC penetrates better s.c from the solution in decyl oleate than from solution in mineral oil.

On the basis of an analysis of profiles of permeation it is possible to set a hypothesis that beta-carotene is permeating through 6 first layers of the horny layer, and its stopped by the barrier which is probably the s.c. intercellular cement. Attempts to balance the applied BC amount with the recovered amount from strips showed that these amounts were balancing only in case of applying the BC solution in decyl oleate, after 1 hour from the application. It can mean, that beta-carotene penetrating across the barrier of intercellular cement, is slowly dissolving in it and is slowly permeating deep into the horny layer.

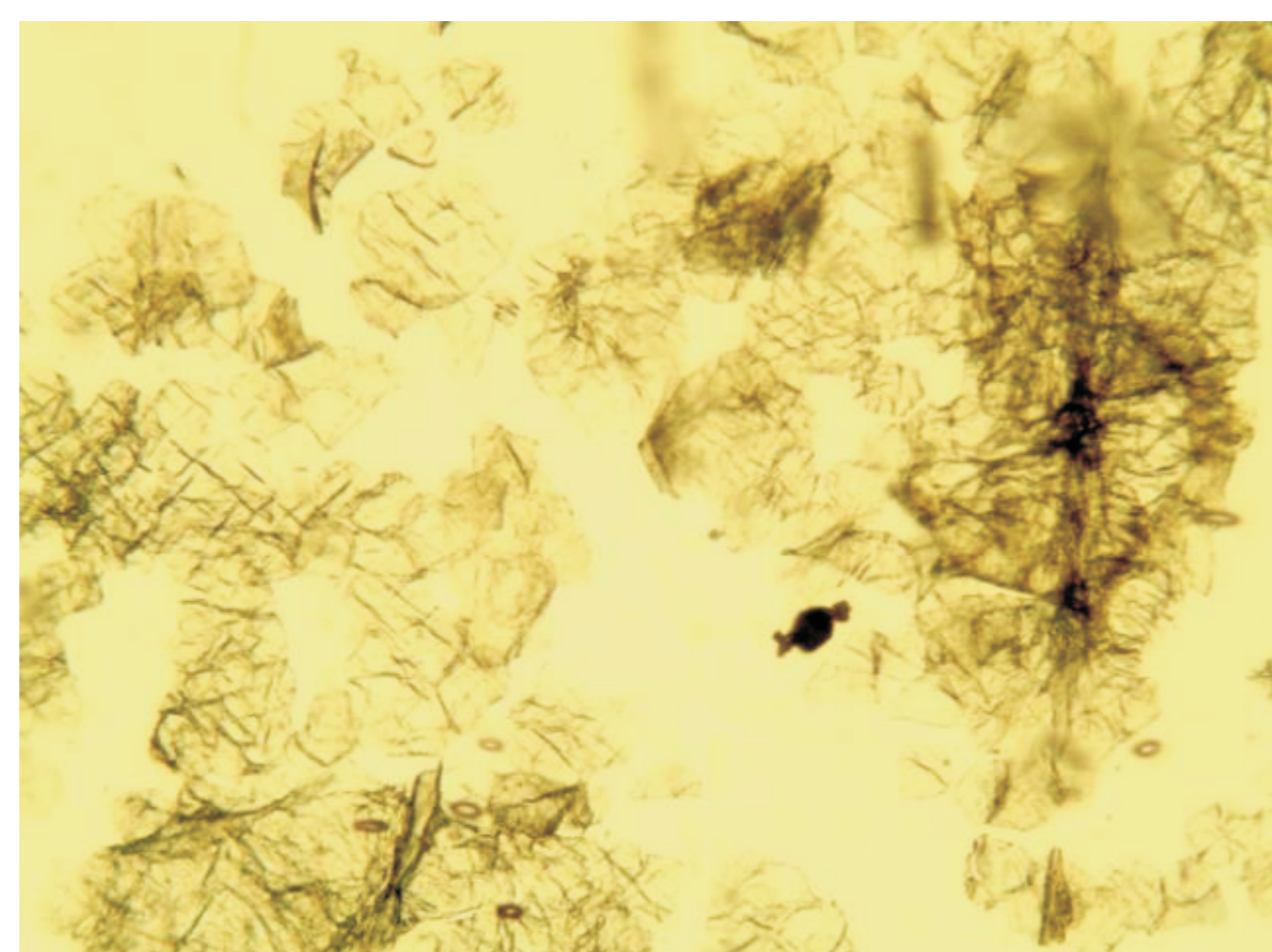


Fig. 5. An example of microscopic image of adhesive tape after stripping, a dark BC crystal is clearly visible between corneocyte aggregates

According to Jacobi and Teichmann after applying BC solutions in different emollients a stripping was conducted again and strips were examined under the optical microscope. Microscopic examinations were aimed as an attempt of determination of distribution pattern of the beta-carotene in the horny layer. We also intend to check whether beta-carotene is colouring corneocytes. During these examinations crystals of beta-carotene were found between corneocytes both after application of BC solution in decyl oleate and mineral oil we did not find any signs of BC solubilization in corneocytes (Fig. 5)

After the topical application to the skin surface of preparation with beta-carotene a crystalline depot of this carotenoid is created in the stratum corneum intercellular cement. Based on conducted research it is possible to present the hypothesis, that intercellular cement is a barrier for the permeation of beta-carotene into the epidermis. Therefore conducting research on the solubility of beta-carotene in stratum corneum lipids is essential.

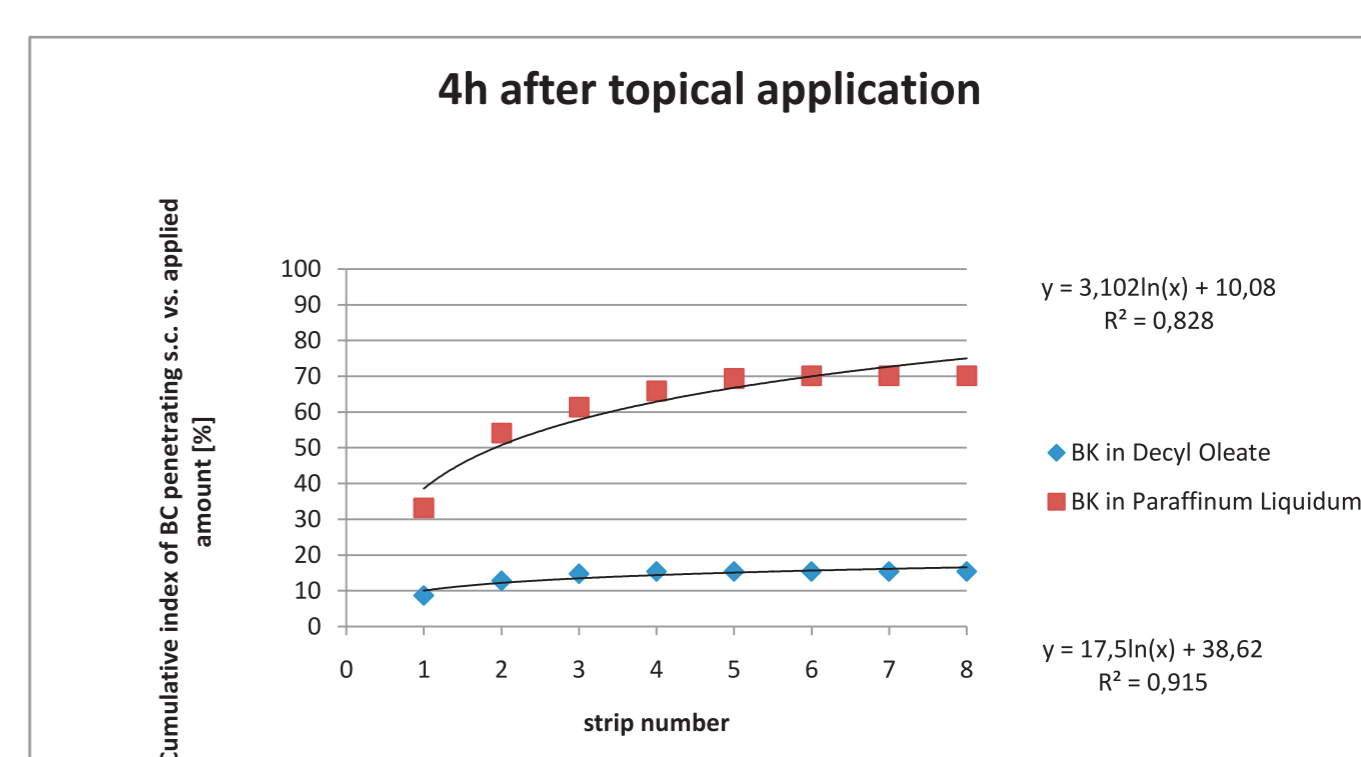
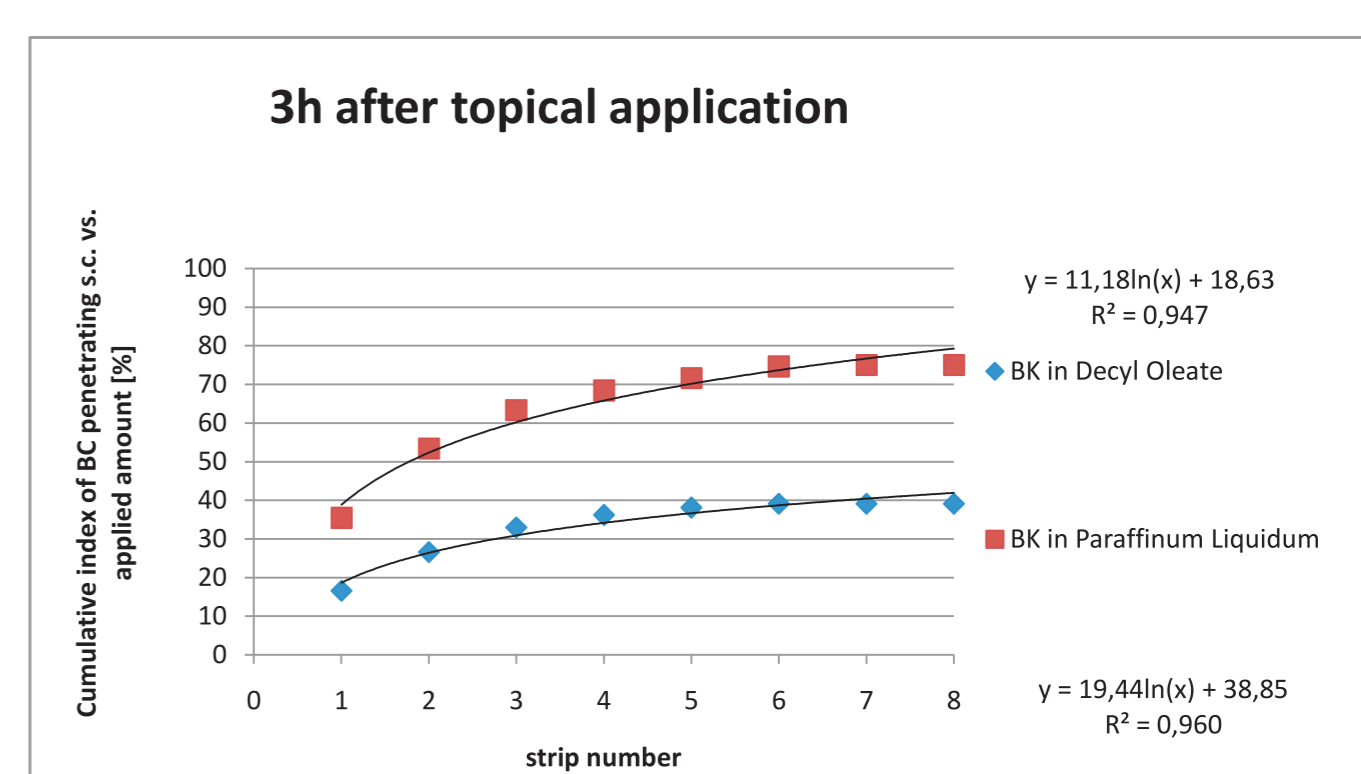
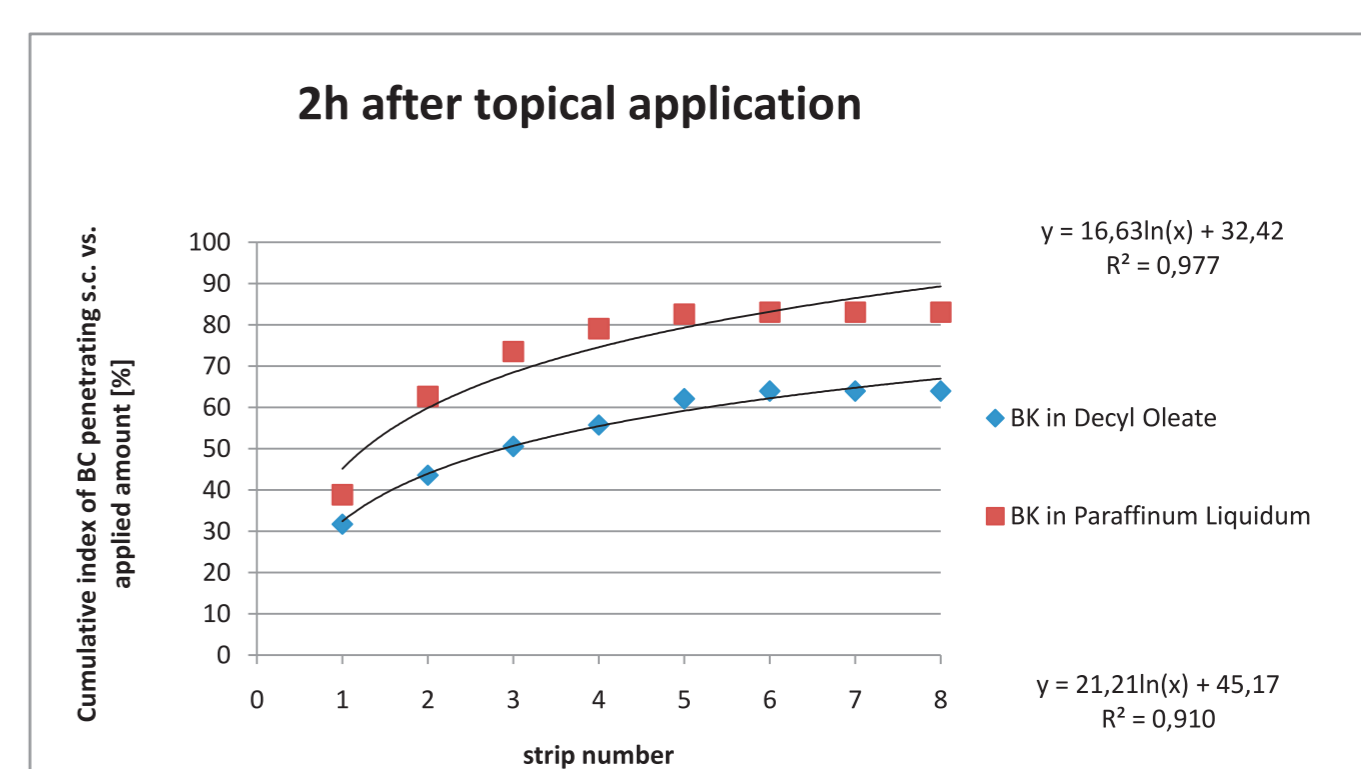
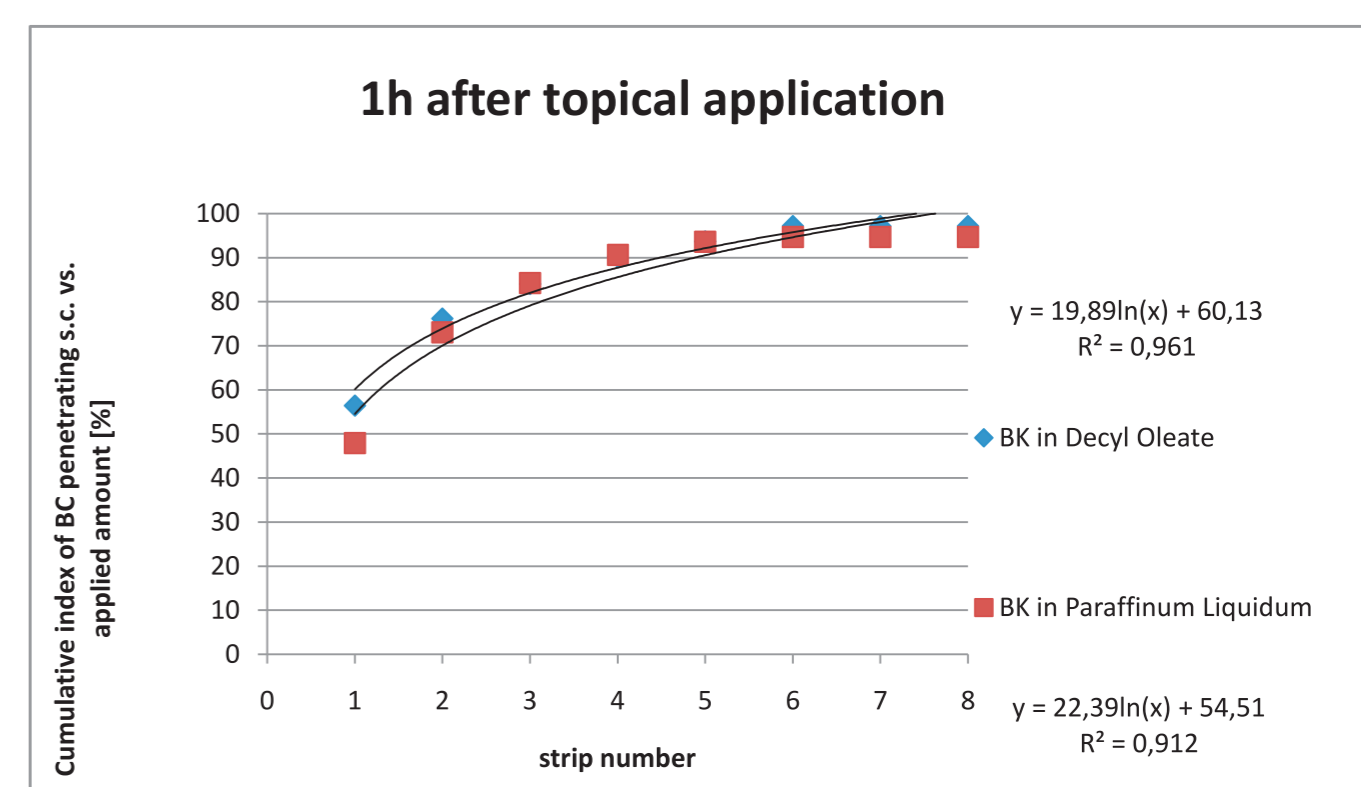


Fig 1-4. Cumulative index of BC penetrating s.c. vs. applied amount.