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Nanocrystals – a “needle free injection” of drug into the skin

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In 2007 the first cosmetic product containing nanocrystals was introduced by Juvena Switzerland with line JUVEDICAL and other products such as e.g. platinum rare from la prairie followed. Nanocrystals are particles made of pure cosmetic or pharmaceutical active, having a size in the nanodimension (few nm to < 1,000 nm). Dermal penetration enhancement takes place theoretically by 3 effects:

1. increased saturation solubility (thus increased concentration gradient) and
2. increased dissolution velocity, both compared to micrometer-sized powders
3. high adhesion to skin

The literature reports increase in penetration and distinct increase in bioactivity. For rutin nanocrystals an increase in the antioxidant activity in the skin was reported by a factor 1,000. The rutin nanocrystals were 2 x more effective in increasing the sun protection factor (SPF) in a human irradiation study at only 1/500 concentration of dissolved active [1].

Within the study a formulation against couperosis was developed containing rutin nanocrystals and nanostructured lipid carriers (NLC) loaded with vitamin K1 and vitamin A1. NLC are also described having a penetration enhancing effect by forming an occlusive film.

A direct comparison of rutin nanocrystals to rutin NLC could not be performed, due to the fact that rutin is poorly soluble in lipids. Only comparison of release of lipophilic actives in different carrier systems was possible. This should give evidence which carrier might be more efficient in dermal delivery. Therefore the penetration form rutin nanocrystals and vitamin A1 loaded NLC were compared by performing an ex vivo tape stripping test.

The results obtained were shown by penetration profiles (fig. 1 and 2) plotting the concentration in the strips ($\mu\text{g/ml}$) versus the relative stratum corneum thickness (%).

After 20 minutes, the rutin nanocrystals show a very pronounced penetration as indicated by the high concentrations visualized by horizontal bars, especially in the upper 60% of the stratum corneum. It clearly indicates superior penetration enhancing effects compared to NLC.



Based on short exposure time and high concentration observed, the nanocrystals resemble an injection or micro-needle like penetration behavior.

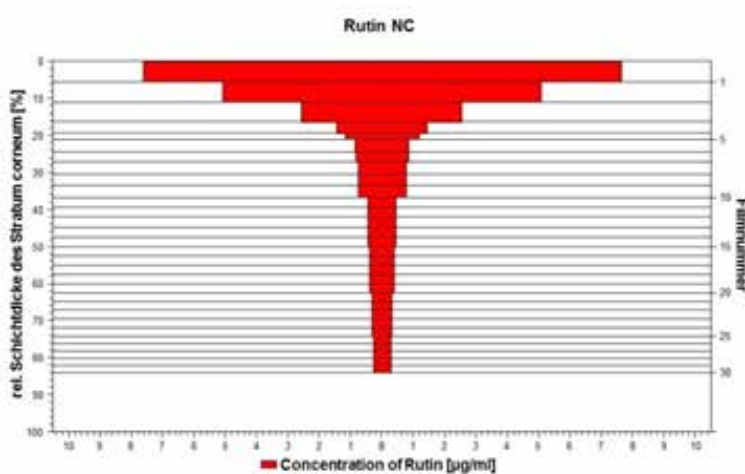


Fig. 1: Penetration profile of rutin nanocrystal suspension on pig ear skin after 20 minutes application time

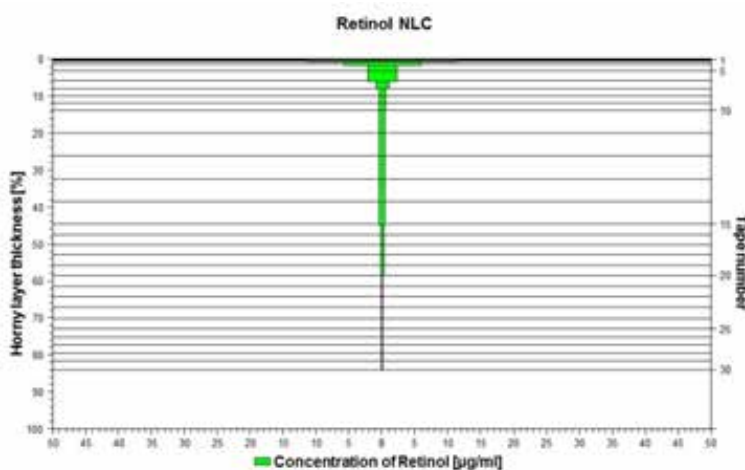


Fig. 2: Penetration profile of vitamin A1 NLC suspension on pig ear skin after 20 minutes application time

Very interesting was - against all expectations - that the combination of rutin nanocrystals and NLC did not further improve rutin penetration. On the contrary addition of NLC slightly reduced rutin penetration. This is an important finding for future selection of formulation compositions.

[1] Petersen, R.D., PCT/EP2007/009943, 2006, Abbott GmbH Germany