# Identification of topical excipients with high performance spreadability

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## 1. Introduction

The spreading of cosmetic oils on the human skin can be defined as the capability of substances to more or less quickly spread on the capillary active, chemically heterogeneous horny layer and to form a film [1]. For the reason that this is closely connected with characteristics like the fattening behavior of the emollient, spreading values are an important product trait for every cosmetic oil.

A common technique for determination of the spreading values has been described by Zeidler [1]. However, this technique has two major disadvantages:
As it is an in-vivo method, there is no possibility to test new substances without established toxicological profile and furthermore only an indirect calculation of the spreading area is part of this technique. Hence a new method to determine the spreading value as the kinetic persecution of the area wetted by a drop and the optical analysis thereof is presented. And as the surface roughness has a distinct influence on the spreading of emollients, investigations with regard to different surface roughness on an artificial membrane were made.

## 2. Material and methods

### 2.1 Emollients

The emollients tested are: Dicaprylyl Ether, Dibutyl Adipate, Decyl Oleate, Ethylhexyl Stearate, Cetearyl Isononanoate, Oleyl Erucate, Squalane, Octyldodecanol, Caprylic/ Capric Triglycerides and Isopropylmyristate from Cognis Deutschland GmbH & Co KG, Düsseldorf, Paraffinum liquidum and Paraffinum perliquidum from Hansen & Rosenthal KG, Hamburg, C12-15 Alkyl Benzoate from Finetex Inc., New Jersey, Dimeticone Copolyol from Wacker Chemie GmbH, Burghausen and Cyclopentasiloxan DC 245 from Dow Corning S.A., Belgium.

Different artificial collagen materials were tested with regard to their suitability as a skin substitute. Substitute 1 and 2 can be distinguished via their different surface characteristics. Both substitutes have during experiments additionally been modified with regard to their moisturization.

The moisturization of skin substitutes has been achieved via

a) keeping the substitutes in chambers with defined humidities and controlled temperature
b) addition of suitable humectants

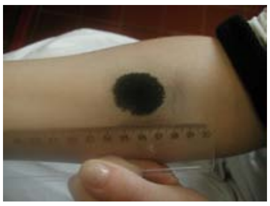
After conditioning the hereby precisely wetted membranes were spanned tensely.

### 2.2 Determination of spreading behaviour

5 respectively 10µl of the emollient was applied with a µl syringe on the forearm of test persons or on skin substitutes. After application time graphite powder was spread on the forearm. The surplus powder was removed carefully.

Evaluation of the spreading area was performed via Olympus C-3030 camera with Camedia Master 2.0, Olympus Optical LTD picture software.

The time between application and measurement was 5 respectively 10min. For analysis pictures were taken and the spreading area (mm²) was evaluated by analySIS software, Soft Imaging System GmbH.



Picture: Optical analysis of the spreading area

### 2.3 Determination of topography of materials

All tested materials have been determined topographically during experiments. Topography of skin substitutes (roughness) was examined by a Hommel surface measurement device and compared to human skin.

Surface energy of membranes was determined via determination of the contact angle of calibration fluids on these membranes and calculation of the surface energy via the Owens, Wendt geometric mean model.

Viscosity was tested using a viscosimeter by Höppler at 20°C.

## 3. Results and discussion

### 3.1 Determination of spreading behaviour

First experiments were carried out on human skin and on substitute 1 and 2 and compared to previous published data.

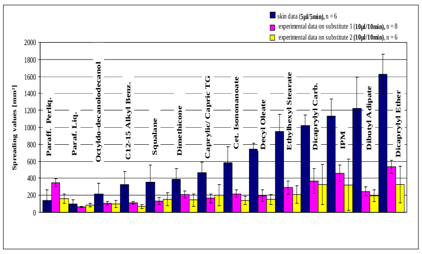


Fig. 1: Comparison of experimental data with graphite on human skin and on substitute 1 and 2

The spreading area can be easily defined both on skin and on the substitutes and a precise optical capture is feasible. The analysis of the emollient area coloured with powder is promising. Experimental data on skin and previously published data are comparable. Experimental data on substitutes is lower than data on skin, however, for some selected emollients a correlation can be found:

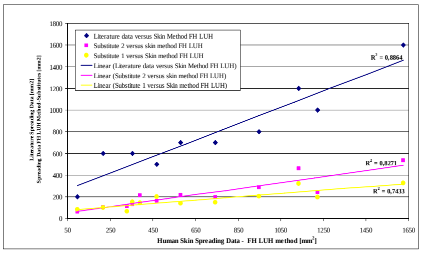


Fig. 2: Correlation of spreading data on skin and skin substitutes (1 and 2) with previous published data and FH LuH data on skin

Establishing correlations with previous published data was successful. Topographical investigations should gain further knowledge about the surface characteristics of the substitutes.

### 3.2 Topography of materials

#### 3.2.1 Roughness

In table 1 the results for investigation of roughness of the materials are given.

| Material | Roughness Ra [µm] |
|---|---|
| Substitute 1 | 2.72 (+/- 0.94) |
| Substitute 2 | 1.72 (+/- 0.36) |
| Skin (replica) | 13.15 (+/- 2.5) |

Table 1: Roughness of skin substitutes (dry)

The dry substitutes are not comparable to human skin replica roughness. Hence moisturized substitutes were conditioned and investigated with regard to roughness.

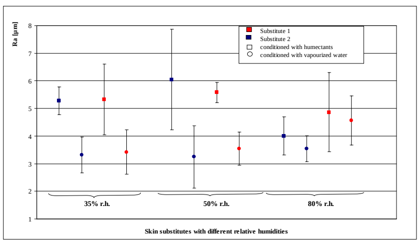


Fig. 3: Roughness of moisturized skin substitutes

Via the moisturization of substitutes more skin-like roughness values can be achieved. There is a distinct difference if the relative humidity has been achieved via vaporized water or via humectant mixtures. However, the substitutes are quite indifferent to relative humidities.

#### 3.2.2 Viscosity of oils

Feasibility of the method and the membranes has been further evaluated by correlation of spreading data and viscosities of oils.
A good correlation can be found between spreading data on skin and on substitute 2.

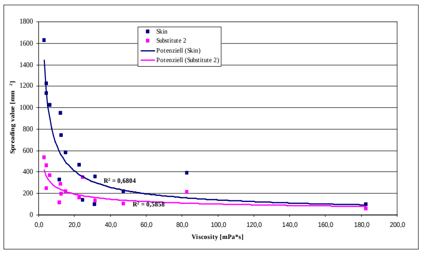


Fig. 4: Correlation of viscosity of oils and spreading values with graphite powder on skin and substitute 2

#### 3.2.3 Surface energy

Surface energies were only calculated for the dry substitutes and the substitutes conditioned with vaporized water (80-100% r.h.).

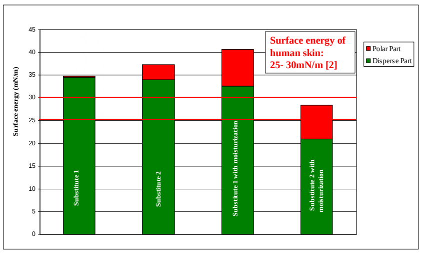


Fig. 5: Surface energy of dry and moisturized skin substitutes

Surface energy result hint at that the moisturized substitute 2 seems to be very suitable for determination of spreading values.

### 3.3 Spreading on moisturized substitutes

Spreading experiments on moisturized substitutes were carried out on the substitute 2 conditioned with vaporized water (80-100% r.h.).

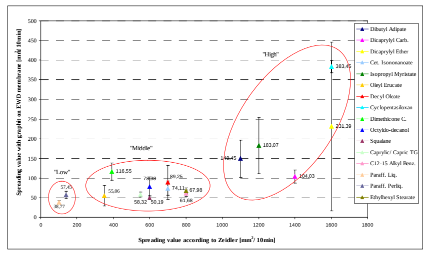


Fig. 6: Spreading behaviour of emollients on moisturized substitute 2

Spreading values on the moisturized substitute are more skin like than on the dry substitute. Differentiation is difficult, however, low, middle and high spreading emollients can be distinguished.

## 4. Conclusions

It could be shown that the new method of determination of spreading values with graphite powder is feasible not only on human skin but also on dry and moisturized skin substitutes. Data on skin substitutes is promising and will be expanded especially with regard to other methods for cosmetic testing.

## 5. References

[1] Zeidler, U., Über das Spreiten von Lipiden auf der Haut, Fette, Seifen, Anstrichmittel, Vol. 87, No. 10, Düsseldorf, 1985

[2] El Khyat, A., Mavon, A., Leduc, M., Agache, P., Humbert, P.: Skin critical surface tension. A way to access the skin wettability quantitavely, Skin research and technology, 2 (2), 91- 96, 1996