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CORRELATION BETWEEN RHEOLOGICAL STUDIES AND ORGANOLEPTIC COSMETIC EMULSION WITH LANOLIN – NATURAL EMULSIFIER

KORELACJA POMIĘDZY BADANAMI REOLOGICZNYMI
I ORGANOLEPTYCZNYMI EMULSJI KOSMETYCZNYCH
Z EMULGATOREM NATURALNYM – LANOLINĄ

Abstract

In this paper rheological investigations of cosmetic emulsions, prepared with lanoline as an emulsifier were carried out. The strong influence of emulsifier content and the applicability of rheological measurements to validate cosmetic products were shown.

Keywords: cosmetic emulsions, lanolin mixer, rheology

Streszczenie

W artykule przeprowadzono badania reologiczne emulsji kosmetycznych sporządzonych z wykorzystaniem lanoliny jako emulgatora, za pomocą miksera recepturowego. Wykazano silny wpływ zawartości emulgatora na konsystencję produktu oraz przydatność pomiarów reologicznych do oceny jakości preparatów kosmetycznych

Słowa kluczowe: emulsje kosmetyczne, lanolina, reologia

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1. Introduction

The word lanolin comes from the Latin word “lano”, which means wool, since it is obtained from wool fat. When the time for sheeps clipping is approaching, their sebaceous glands secrete a large amount of sebum, which is deposited on the wool. Lanolin is obtained during cleaning of wool since the residual lanolin content of dry, clean wool fibres should not be higher than 2–3%. Surplus fat is collected in form of O/W (oil in water) emulsion, which, after dewatering by centrifugation, is subjected to further purification process. The obtained material is used in cosmetics and pharmacy [1–3].

Pharmaceutical lanolin occurs in the form of golden-yellow sticky mass, with a specific odor, containing no more than 0.25% w/w of water. Chemically it is a complex mixture of esters of high molecular weight aliphatic, steroid and triterpenoid alcohols which does not contain either glycerol or glycerides. It melts in 38–44 °C range [1]. Since the composition of lanolin resembles the intercellular lipids of the stratum corneum, from ancient times it has been used in cosmetics for skin care and presently it is widely used in topical pharmaceutical formulations and cosmetics [4, 5]. As a hydrophobic vehicle, it forms emulsions with water, but due to the presence of polar functional groups it possesses emulsifying properties and can absorb big amount of water; therefore lanolin is used in the preparation of water-in-oil creams, ointments, lipsticks, nail polish remover, hair lotions and deodorants, it ensures the emollient qualities that protect and care for our skin and hair.

Being a natural product with surface active properties, lanolin has many advantages but also some disadvantages, especially from the cosmetic point of view, the most important are: strong smell, high viscosity, yellow color and the poor coating ability. Those negative characteristics can be modified through physical and chemical processes and the resulting derivatives may be better suited to the specific purposes.

The first group of derivatives of the raw lanolin is lanolin modified physically. It is clear, viscous, rubs better on the skin and has a low viscosity. Thus modified it comes in form of liquid, but has all the features of the parent compound. It is used for the manufacturing of face creams, lotions, baby oils, hair preparations and preparations for tanning. The next group of physically modified lanolin may include so-called lanolin wax. It has better W/O emulsifying capabilities than the basic product and also fulfills an important role as a means to maintain the pigment in the skin. Therefore, it is widely used as a thickening agent in hard cosmetic formulations, such as lipsticks. The largest group of lanolin derivatives are its various chemical modifications, which can be performed on raw, physically unmodified product, as well as on liquid lanolin and lanolin waxes. Hydrogenated lanolin is a soft colorless paste. Preparations containing it in its composition are better absorbed through the skin. Acetylated lanolin has a lower melting point and reduced emulsifying properties. It becomes more hydrophobic than the parent product. It is used frequently in sunscreen preparations, especially for children. Also, it rarely causes allergic reaction, and therefore it is used in cosmetics for people with sensitive and injured skin [6].

In this paper three cosmetic type emulsions with various lanolin content were prepared and investigated by sensory and rheological analysis.

2. Experimental

The research part concerned preparation, evaluation and comparison of properties of three lanoline containing cosmetic type emulsions. Different concentrations of pharmaceutical grade lanoline were used according to the recipe. The emulsion compositions are given in Table 1.

Table 1

Cosmetic emulsion formulations.

Sample number	Lanolin [g]	Rice oil [g]	Distilled water [g]	Lanolin concentration [% mas]
1	1.2	14.4	14.4	4
2	1.5	14.25	14.25	5
3	3	13.5	13.5	10

The emulsions were prepared using a pharmaceutical mixer Unguator 2100, by Gako, which became a standard in small scale pharmaceutical preparations. The emulsion+ procedure was used in all cases.

Sensory analysis of emulsions was performed by 50 qualified people (cosmetology students), who were asked to assess their scent, color, texture and spreadability on the skin and complete simple questionnaires.

Table 2

The development of organoleptic tests

Scent	Color	Consistence	Spreading on the skin
unpleasant	colourless	very heavy	very difficult to spread
quite unpleasant	not very intensive	heavy	difficult to spread
middling scent	mid-intensive	mid-heavy	mid-difficult to spread
pleasant	intensive	light	easily spreading
very pleasant	very intensive	very light	very easily spreading

To objectify results for the last two columns, which can bear a highly individual mark, the rheological properties of prepared emulsions were measured using rotational rheometer.

3. The results of the organoleptic tests

Results of organoleptic tests of investigated emulsions are presented graphically below. Fig. 1 shows the results of scent comparison.

Basing on the results of flavor assessment, it can be stated that increase of lanolin concentration makes the scent more pleasant.

The next test covered the consistency of emulsions and its results are shown in Fig. 2.

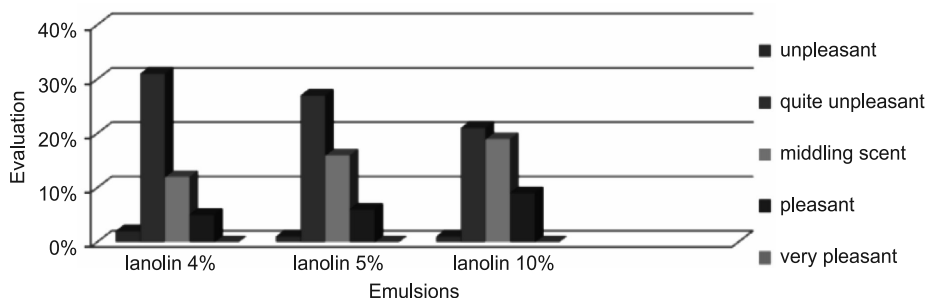


Fig. 1. Rating flavor of three lanoline containing emulsions
Rys. 1. Ocena zapachu trzech emulsji zawierających lanolinę

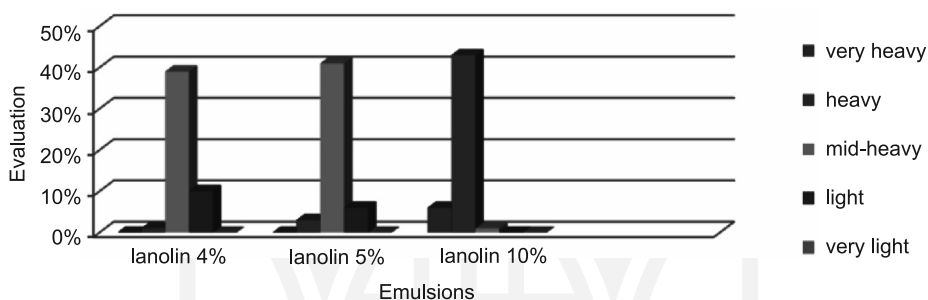


Fig. 2. Consistency rating of three cosmetic emulsions (lanolin-water-rice oil), containing 4%, 5%, and 10% of lanolin

Rys. 2. Ocena konsystencji trzech emulsji kosmetycznych (lanolina-woda-olej ryżowy) zawierających 4%, 5% i 10% lanolinę

The results of consistency assessment can be summarized as: increase of lanolin concentration in the cosmetic emulsion makes it heavier.

The comparison results of emulsion color are presented in Fig. 3.

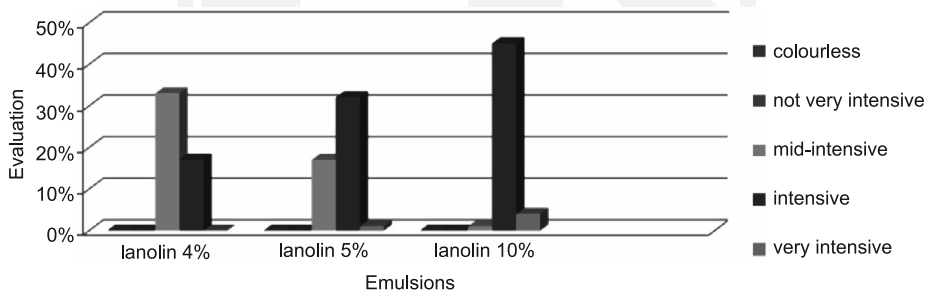


Fig. 3. Assessment of color in three cosmetic emulsions (lanolin-water-rice oil), containing 4%, 5% and 10% of lanolin

Rys. 3. Ocena koloru trzech emulsji kosmetycznych (lanolina-woda-olej ryżowy) zawierających 4%, 5% i 10% lanolinę

Based on the study of color, it can be concluded that the greater the lanolin concentration in emulsion, the more intense the color.

The spreading tests are closely related to consistency. Their results are presented in Fig. 4.

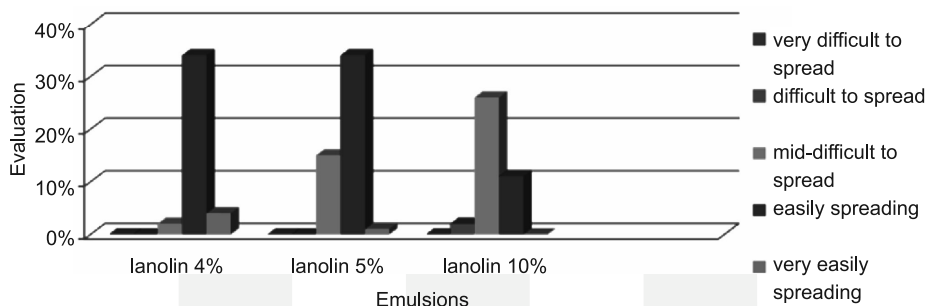


Fig. 4. Assessment of spreading of a cosmetic emulsion (lanolin-water-rice oil) on the skin, with concentrations of 4%, 5% and 10% of lanolin

Rys. 4. Ocena rozprowadzania na skórze emulsji kosmetycznych (lanolina-woda-olej ryżowy) zawierających 4%, 5% i 10% lanoliny

From this figure it can be concluded that the amount of lanolin in the cosmetic emulsion affect its spreading ease. Increasing the concentration of emulsifier in a cosmetic preparation results in difficulties with smearing on the skin.

4. The rheological tests

Along with sensory evaluation, rheological tests were performed. The study of rheological characteristics of cosmetic emulsions was made with rotational rheometer HAAKE RS75, using cone-plate system with 60 mm diameter and 0.5° angle.

Rheological properties were tested at 32°C and 37°C . The first one corresponds to skin temperature (direct application temperature), the second to human body temperature (prolonged action). As a basic test, flow curves were determined.

In Figure 5 flow curves representing the cosmetic emulsion (lanolin-water-rice oil), with various lanolin concentrations are shown. It can be seen that increase of lanoline concentration in the emulsion leads to an increase of yield stress, which corresponds to consistence tests results.

The next graph shows viscosity curves of investigated emulsions taken at 32°C , within the typical shear rate range. The increase in viscosity is proportional to the concentration of emulsifier in the studied emulsions.

Next figures show results of analogous tests performed at 37°C , which is close to lanolin melting temperature. No qualitative differences can be observed. It which suggests that within the investigated compositions lanolin is completely dissolved in the emulsion.

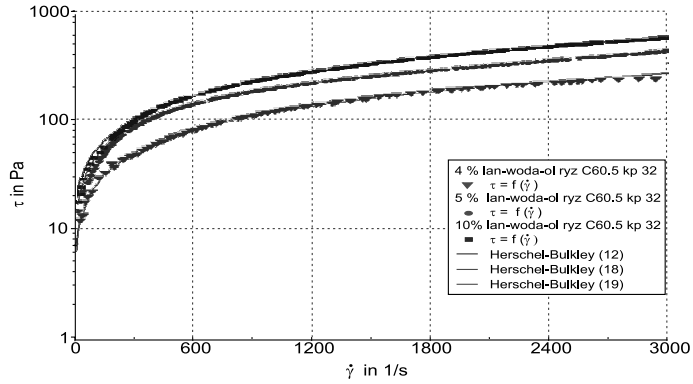


Fig. 5. Flow curves of cosmetic emulsions lanolin-water-rice oil at 32 °C

Rys. 5. Krzywe płynięcia emulsji kosmetycznych lanolina-woda-olej ryżowy w temperaturze 32 °C

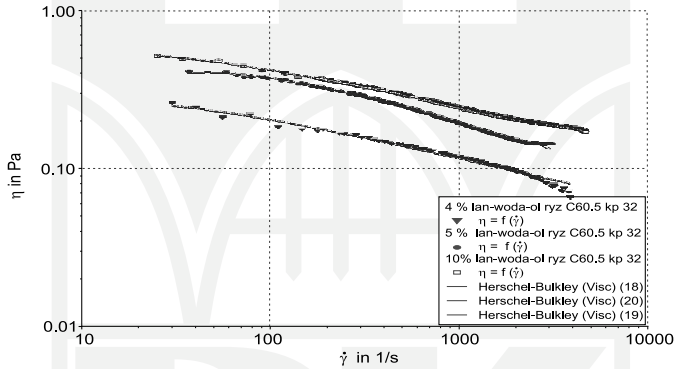


Fig. 6. Viscosity of lanolin-water-rice oil emulsions as a function of shear rate at 32 °C

Rys. 6. Lepkość emulsji w funkcji szybkości ścinania w temperaturze 32 °C

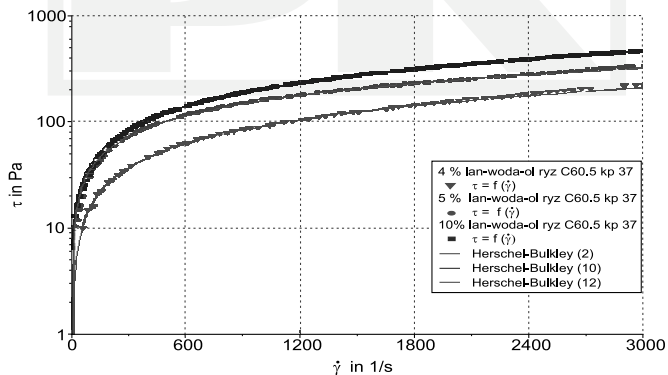


Fig. 7. Effect of lanolin concentration on the flowcurve, for lanolin-water-rice oil at 37 °C

Rys. 7. Wpływ stężenia lanoliny na krzywą płynięcia emulsji kosmetycznej lanolina-woda-olej ryżowy w temperaturze 37 °C

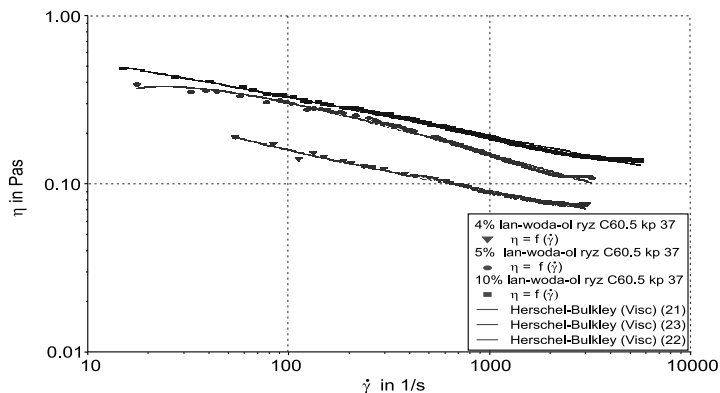


Fig. 8. The viscosity of the cosmetic emulsion lanolin-water-rice oil for various emulsifier concentrations at 37 °C

Rys. 8. Lepkość emulsji kosmetycznej lanolina-woda-olej ryżowy w temperaturze 37 °C

The measurements at different temperatures (32 °C and 37 °C), showed , significant increase in yield stress with increasing concentration of lanolin. The dependence of viscosity on shear stress for the highest lanolin concentration is shown in Fig. 9.

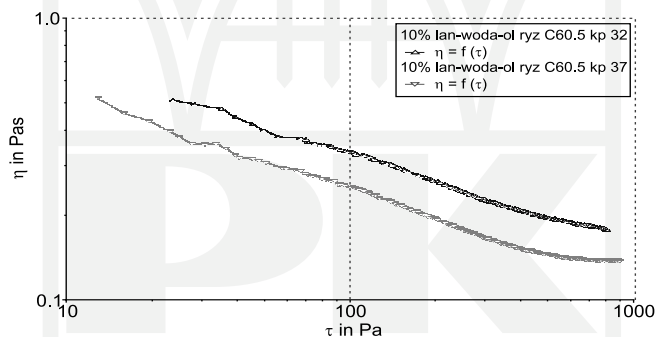


Fig. 9. Effect of temperature on the viscosity as a function of shear stress for 10% lanolin emulsions

Rys. 9. Wpływ temperatury na lepkość 10% emulsji lanoliny w funkcji naprężenia ścinającego

The pattern of all curves indicate that all investigated emulsions are non-Newtonian. Their flow and viscosity curves can be satisfactorily approximated with Herschel-Bulkley rheological model.

5. Conclusions

In this work investigations of cosmetic type emulsions with lanolin acting as an emulsifier as well as rheology modifier, were carried out. Those results can be of some importance, since many synthetic rheology modifiers may lead to allergic reactions, and lanoline as a natural product can be applied instead, giving wide possibilities of controlling the consistency and texture of creams and ointments.

Organoleptic tests revealed that unmodified lanolin can be accepted by majority of testers, even at higher concentrations. Their results, especially those concerning consistency and spreadability, are in a close relationship with rheological properties.

Yield point value is important when testing spreading of emulsion on the skin, and its value affects the subjective assessment of the consistency of respondents. The lowest value of yield stress has an emulsion containing the lowest concentration of lanolin (4%). It corresponds to an organoleptic consistency evaluation results. Viscosity curves presented in Figures 6 and 8 show the highest decrease in viscosity in the case of a cosmetic emulsion containing the lowest concentration used in the system lanolin-water-rice oil. It confirms its high organoleptic assessment of the ease of spreadability.

These results confirm that properly conducted rheological measurements allow for a quick and objective emulsion parameters check.

References

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