RHEOLOGICAL ANALYSIS OF SOME PHARMACEUTICAL GELS CONTAINING TINCTURE OF PROPOLIS♦

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Abstract: In the rheological study of pharmaceutical gels the rheological properties evaluation at different experimental parameters play an important role for their quality control and also for the optimization of their formulation. In this work, four gels with carbopol 940 1% and tincture of propolis in different concentrations: 1, 3, 5, and 7%, have been prepared. The rheological profiles of the gels $\tau = f(\eta, D_r)$ and their spreadability has been analyzed.

Keywords: *gels, rheograms, spreadability, tincture of propolis.*

INTRODUCTION

Consumer acceptability and clinical efficacy of pharmaceutical semisolid preparations like ointments, cream and gels require them to possess optimal mechanical properties (ease of removal from the container, spreadability on the substrate), rheological

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properties (viscosity, elasticity, thixotropy, flowability) and other desired properties such as bioadhesion, desired drug release, absorption, appearance and odor [1, 2].
Formulation characteristics, including viscosity and elasticity are the most important factors in the development and final behavior of semisolid preparations.
In this work, four gels with carbopol 940 1% and tincture of propolis in different concentrations: 1, 3, 5, and 7%, have been prepared. The rheological profiles of the gels $\tau = f(\eta, D_r)$ and their spreadability has been analyzed.

MATERIALS AND METHODS

The gels were prepared according to formulas presented in table 1, using an electrical stirrer at 300 rpm [3]. Gel's rheograms were obtained using a rotational viscometer Rheotest 2.5. The following rheological parameters have been determined [4]:

- shearing tension: $\tau_r = Z \times \alpha$ (dyne/cm^2);

where:
Z = cylinder constant;
α = value well-read on apparatus scale.

- velocity gradient proportional to the number of rotations of the internal cylinder: D_r (s^{-1});
- dynamic viscosity: $\eta = (\tau_r / D_r) \times 100$ (cP).

The spreading capacity of the gel formulations was measured 48 h after preparation by measuring the spreading diameter of 1 g of gel between two 20 x 20 cm glass plates after 1 min. The mass of the upper plate was standardized at 125 g [5]. Weighs of 50 g, 100 g, and 250 g were subsequently placed over the sample at 1 min intervals. The spreading areas reached by the sample were measured in millimeters in the vertical and the horizontal axes. The results were expressed in terms of the spreading area as a function of the applied mass according to the following equation:

$$S_i = d_i^2 (\pi / 4)$$

where S_i is the spreading area (mm^2) resulting from the applied mass i (g) and d_i is the mean diameter (mm) reached by the sample.

Table 1. *Gels composition*

Components	Formula A	Formula B	Formula C	Formula D
Tincture of propolis	1 g	3 g	5 g	7 g
Gel of carbopol 940 1%	up to 100 g	up to 100 g	up to 100 g	up to 100 g

The preparations resulted are emulsioned gels with antimicrobian and healing action (figure 1).

RESULTS AND DISCUSSIONS

The rheograms of the analyzed gels, $\tau = f(\eta, D_r)$ and their spreadability are presented in the figures 2-9.

Figure 1. *Prepared gels (left to right): upper row – only carbopol gel; formula A, formula B; lower row – formula C, formula D*

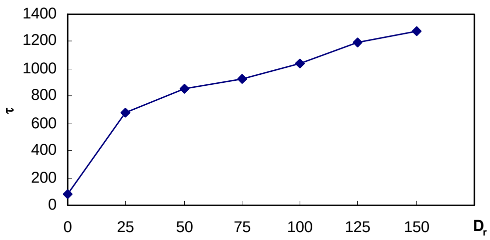

Figure 2. *Shearing tension variation with velocity gradient for formula A*

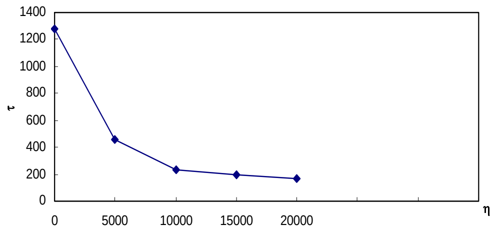

Figure 3. *Viscosity variation with shearing tension for formula A*

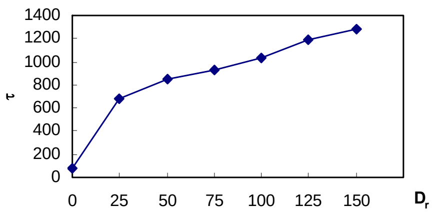

Figure 4. *Shearing tension variation with velocity gradient for formula B*

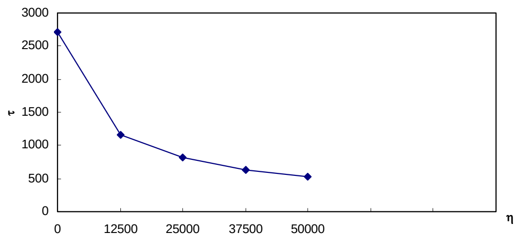

Figure 5. *Viscosity variation with shearing tension for formula B*

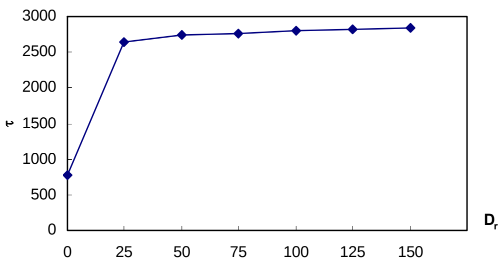

Figure 6. *Shearing tension variation with velocity gradient for formula C*

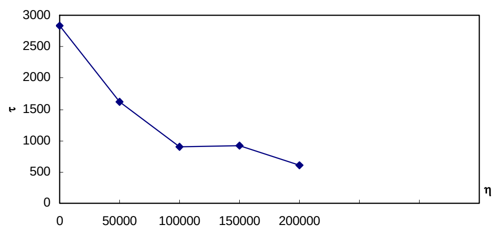

Figure 7. *Viscosity variation with shearing tension for formula C*

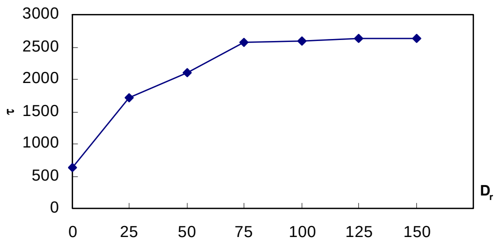

Figure 8. *Shearing tension variation with velocity gradient for formula D*

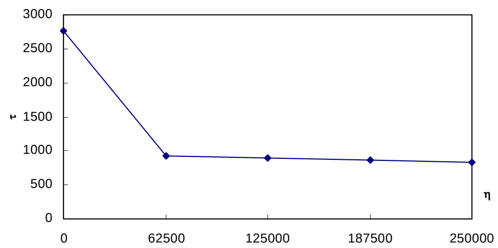

Figure 9. *Viscosity variation with shearing tension for formula D*

From figures 2 - 5 it can be observed a more evident rising of shearing tension with velocity step at formula B than formula A. Product A presents a more extended domain of viscosity variation reported to shearing tension than product B (0 - 6500 cP).
Formula C (fig. 6, 7) presents a more abrupt rising of shearing tension with rotating moment but a slower decreasing of viscosity with rotating moment rising than formulas A and B. Formula D (fig. 8, 9) presents a more abrupt decreasing of viscosity with shearing tension rising than formula C but the variation domain of viscosity is similar.

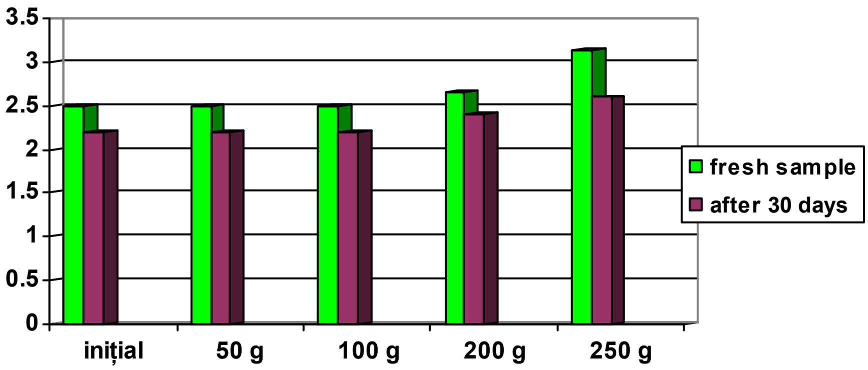

Figure 10. *Spreading area (mm^2) function of the applied mass (gel of carbopol 940 1%)*

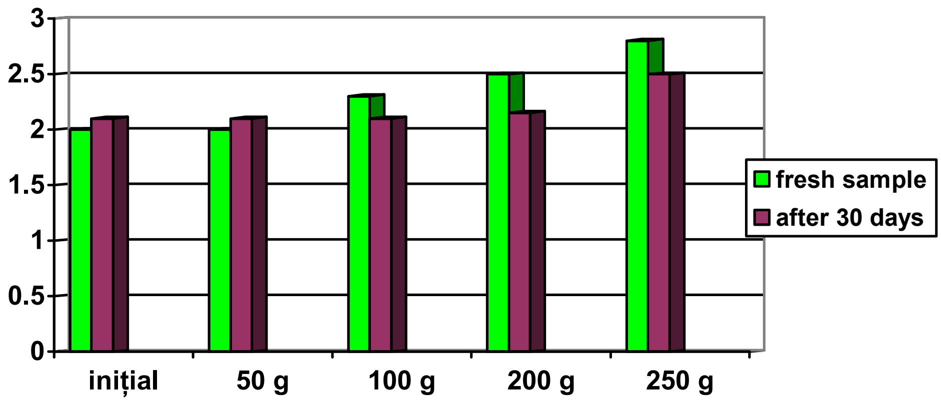

Figure 11. *Spreading area (mm^2) function of the applied mass for formula A*

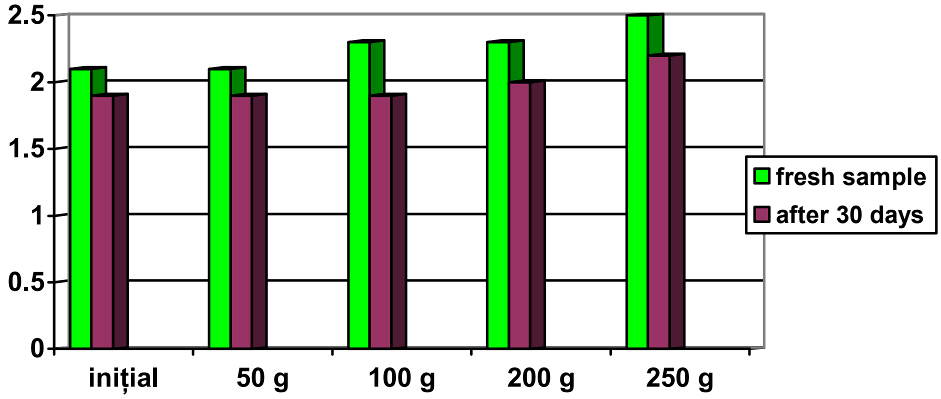

Figure 12. *Spreading area (mm^2) function of the applied mass for formula B*

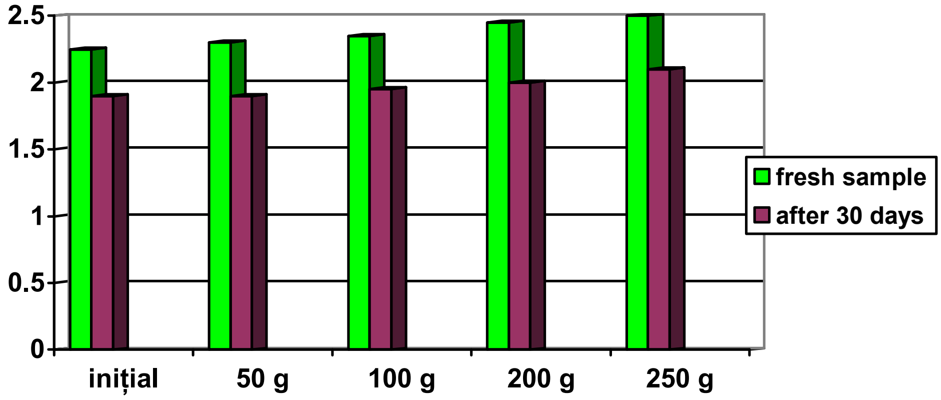

Figure 13. *Spreading area (mm^2) function of the applied mass for formula C*

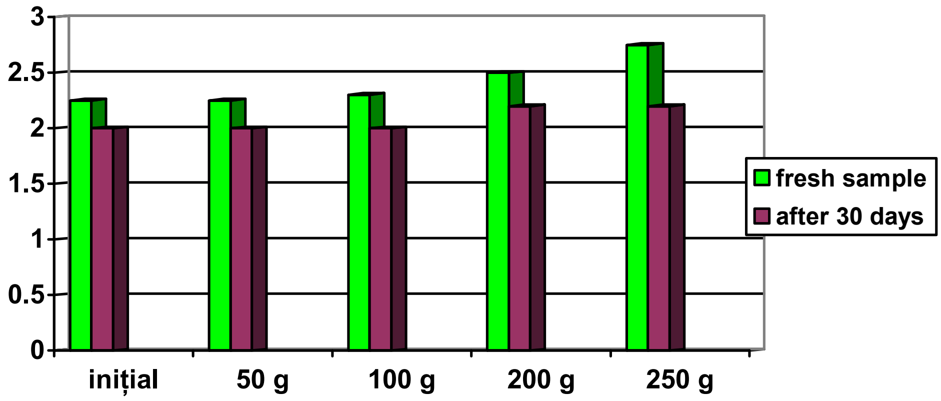

Figure 14. *Spreading area (mm^2) function of the applied mass for formula D*

It can be observed (figures 10 – 14) different values of spreading area of gels analyzed due to their different consistency. The highest values have presented formulas B and C.

CONCLUSIONS

The gels analyzed are from two categories (as it concerns the initial viscosity):
- gels with η > 100 000 cP (formulas C and D);
- gels with η < 100 000 cP (formulas A and B).

From the rheograms presented in the experimental part on remark that the shearing tensions increase with rotating moment rising. At small shearing tensions is produced a decreasing of gel's viscosity.

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