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Research Article

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The study of rheological properties of the fatty ointment base for topical treatment of colds

Isomiddin S. Gulmurodov* and Ievgenii V. Gladukh

Industrial Pharmacy Department, National University of Pharmacy, Kharkiv, Ukraine

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ABSTRACT

In developing of ointment for topical treatment of colds the structural and mechanical properties of the ointment bases contained isopropyl palmitate, beeswax and solid fat in different concentrations have been studied. Amount of isopropyl palmitate 60% remained constant and the ratio of solid fat and bee wax was varied. In order to study thixotropic properties the curve of kinetics deformation of ointments has been constructed. It has been set that when increasing solid fat content in ointment composition and respectively decreasing beeswax the structural and mechanical properties of the base are reduced. The tested ointment bases possess thixotropic properties and plasticity and belong to the class of Bingham systems. Thus ointment with solid fat content of 8%, isopropyl myristate of 60% and beeswax of 32% is superior by its rheological characteristics to other formulations.

Keywords: ointment, treatment of colds, thixotropic properties, rheological properties.

INTRODUCTION

Ointments are a complicated complex of drug substances with a carrier – ointment base, which provides optimum consistency and is an important factor affecting the completeness, the rate of release and absorption of drugs [1,2,4,6,7,9,12].

Most ointments for topical treatment of colds have hydrophobic ointment base consists of alloy of synthetic or semisynthetic components [3,5,8,10,11,13,14]. This type of base has a number of advantages, in particular, long shelf life, stability of physico-chemical properties (as opposed to natural, which often change physical and chemical properties such as melting point, acid, peroxide, essential and other numbers), indifference to the active ingredients and others. However, this type of base is not without drawbacks - the lack of affinity to the skin, the ability to cause local irritative and allergic and action, etc [3,5,6,9,11].

In connection with the foregoing, as an ointment base was chosen fatty base containing hard fat, beeswax and isopropyl [5,8]. This choice of ointment base was caused by the following - components should not have adverse effects on the skin, so maximally are represented natural substances, an ointment base should be softened but not melt at body temperature, and due to this more easily release the components of the active ingredients both in the epidermis of the skin and by inhalation followed by penetration in upper respiratory tract.

The aim of research. In developing of ointment for topical treatment of colds the first stage of our work was to study the structural and mechanical properties of the ointment bases, which contain isopropyl palmitate, beeswax and hard fat in different concentrations.

EXPERIMENTAL SECTION

Rheological (structural and mechanical) properties of the samples were determined using a rotational viscometer «Rheolab QC» (company «Anton Paar», Austria) with coaxial cylinders CC27/S-SN29766. The sample weight of about 17,0 (± 0,5) g was placed in the container of external fixed cylinder, set the desired temperature of experimente, incubation time was 20 minutes. Using the software, with which is equipped device, installed the experimental conditions (shear rate of the inner cylinder (0.1 to 350 s^{-1}), the amount of experiment points on the flow curve of the sample (35) and the duration of the measurement at each point of the curve (1 sec) [6,7,9].

Amount of isopropyl palmitate 60% remained constant and vary the ratio of solid fat and bee wax, the compositions shown in Table 1.

Table 1: The composition of the experimental ointment bases

Components of the base	Base 1	Base 2	Base 3	Base 4	Base 5	Base 6
Solid fat	4	6	8	10	12	15
Isopropyl palmitate	60	60	60	60	60	60
Wax	36	34	32	30	28	25

RESULTS AND DISCUSSION

To justify the component composition were studied rheological properties of different combinations of these substances. In Fig. 1-12 are presented rheograms of ointment bases.

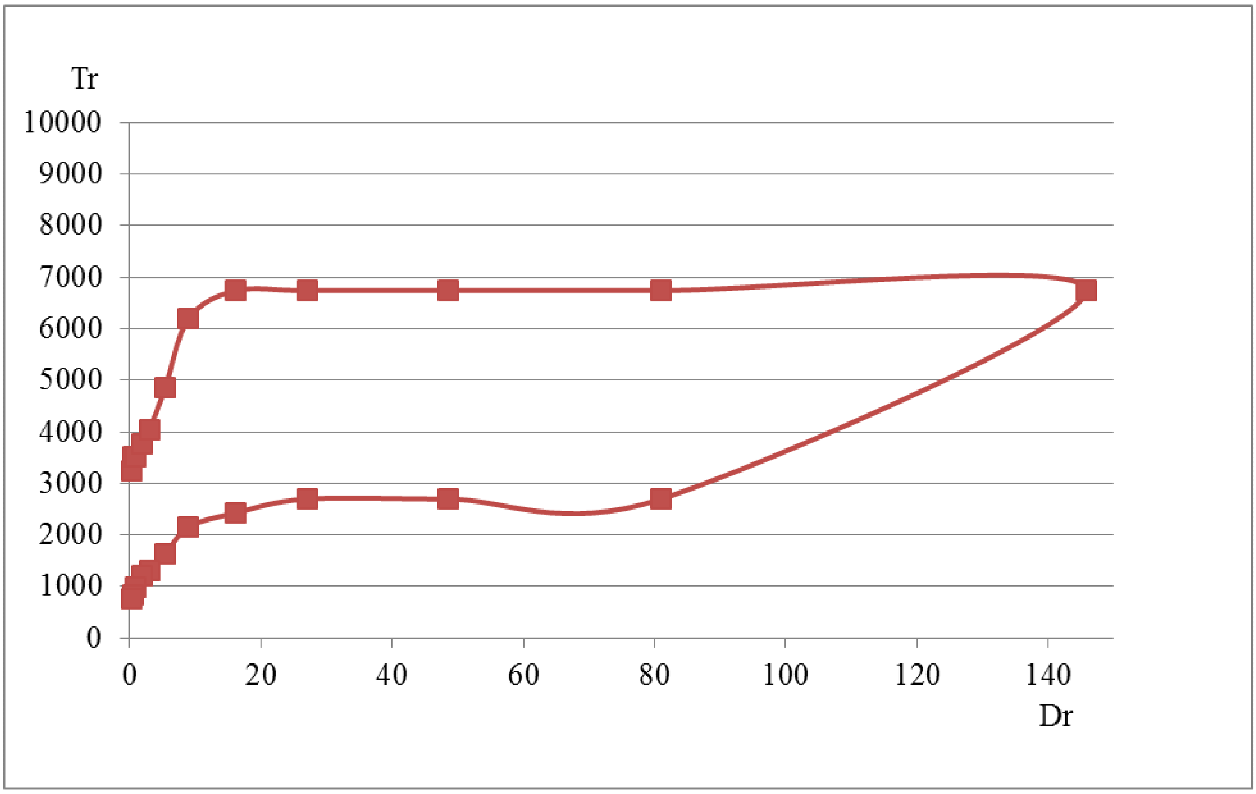

Fig. 1. The dependence of the ointment base № 1 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 20 °C

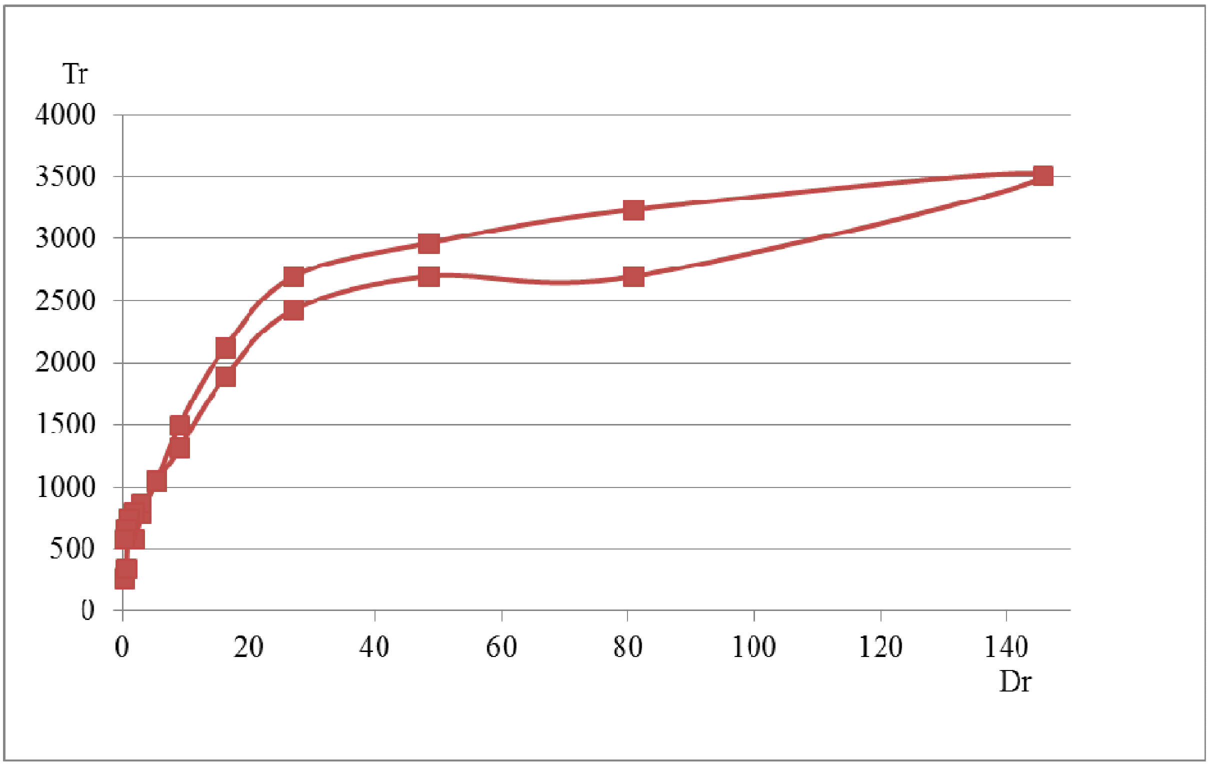

Fig. 2. The dependence of the ointment base № 1 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 34 °C

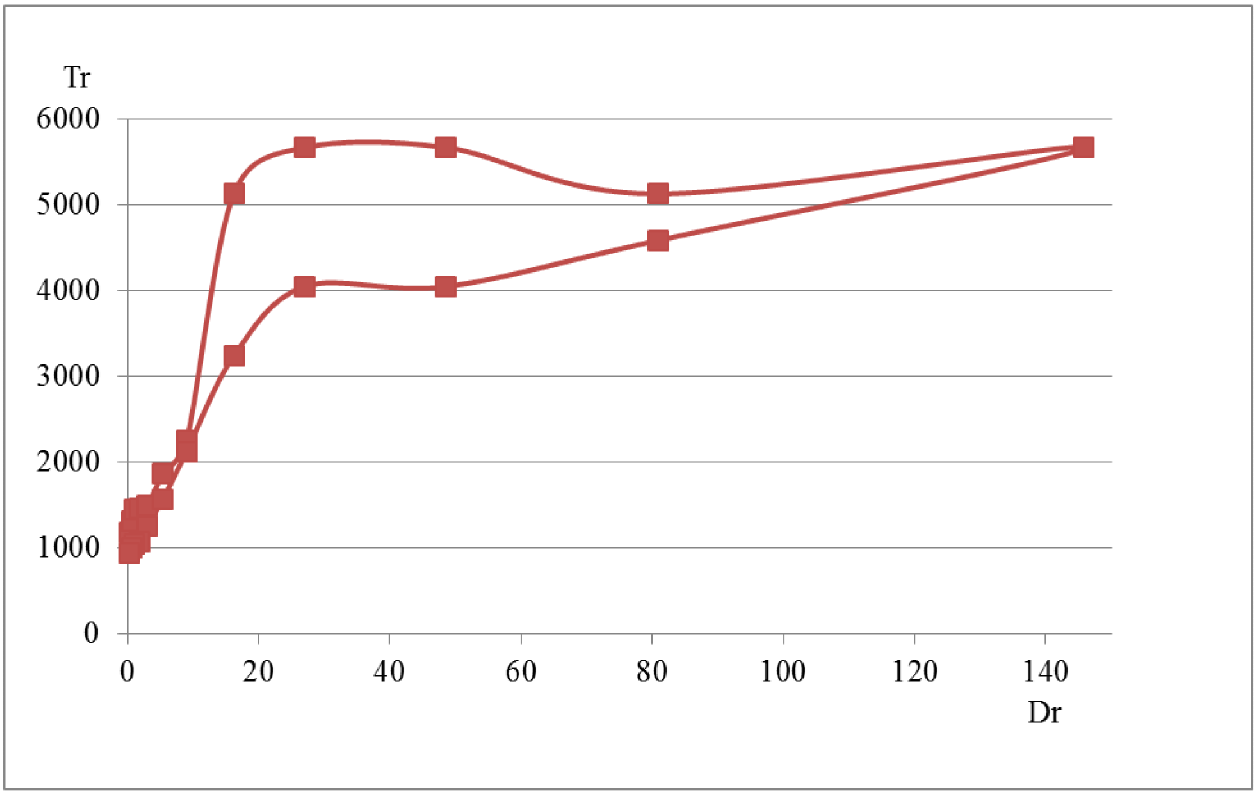

Fig. 3. The dependence of the ointment base № 2 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 20 °C

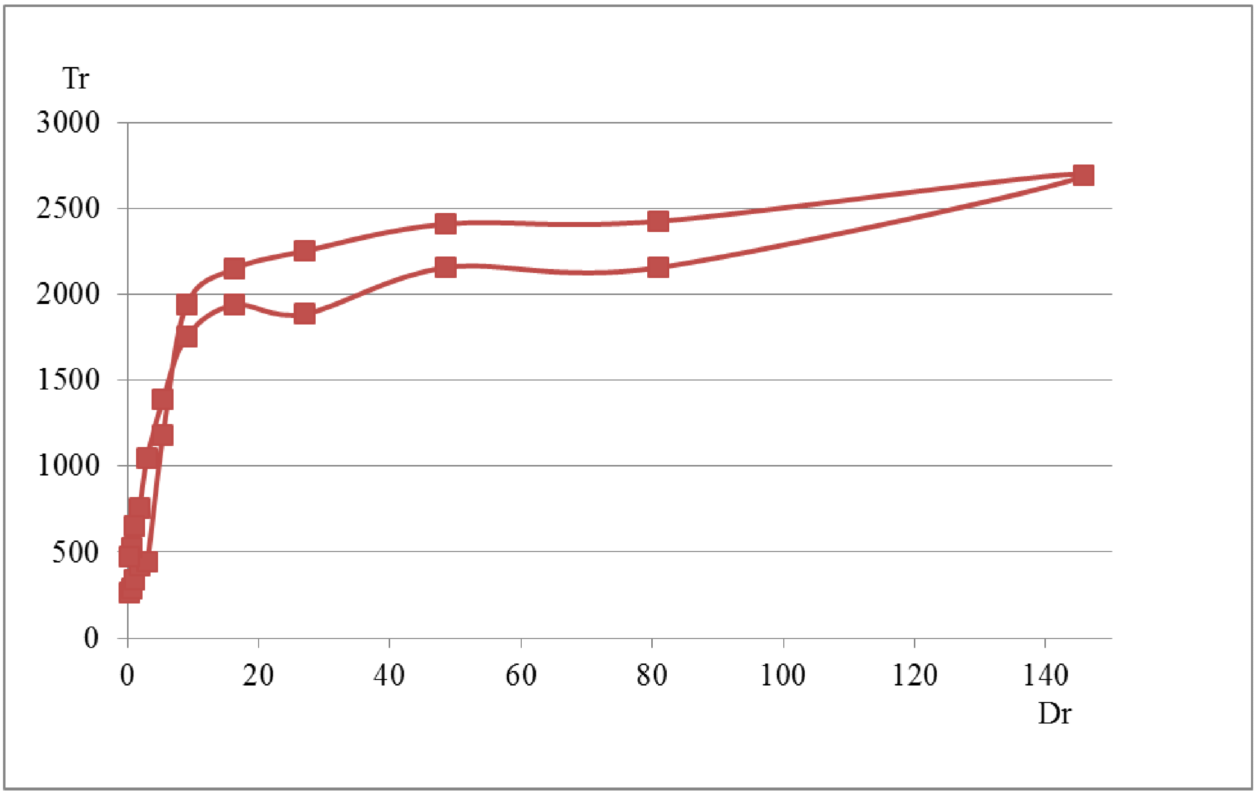

Fig. 4. The dependence of the ointment base № 2 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 34 °C

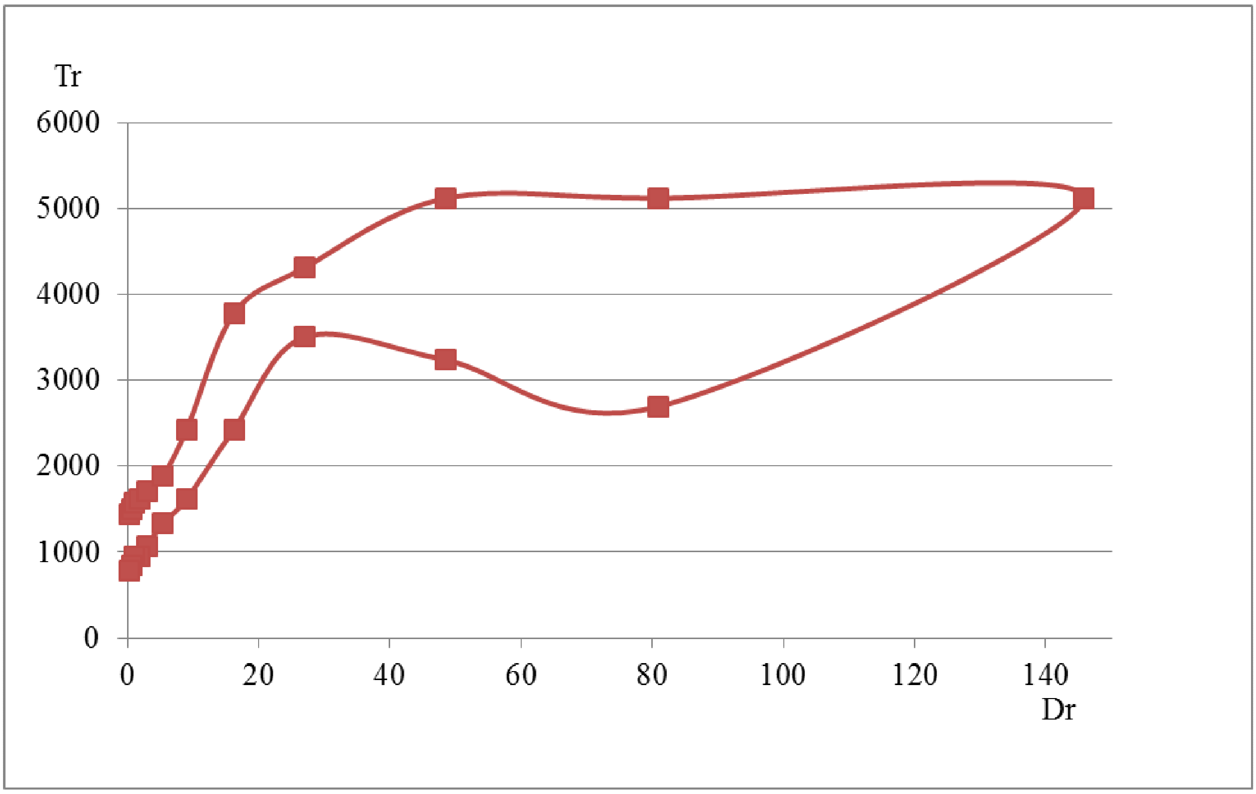

Fig. 5. The dependence of the ointment base № 3 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 20 °C

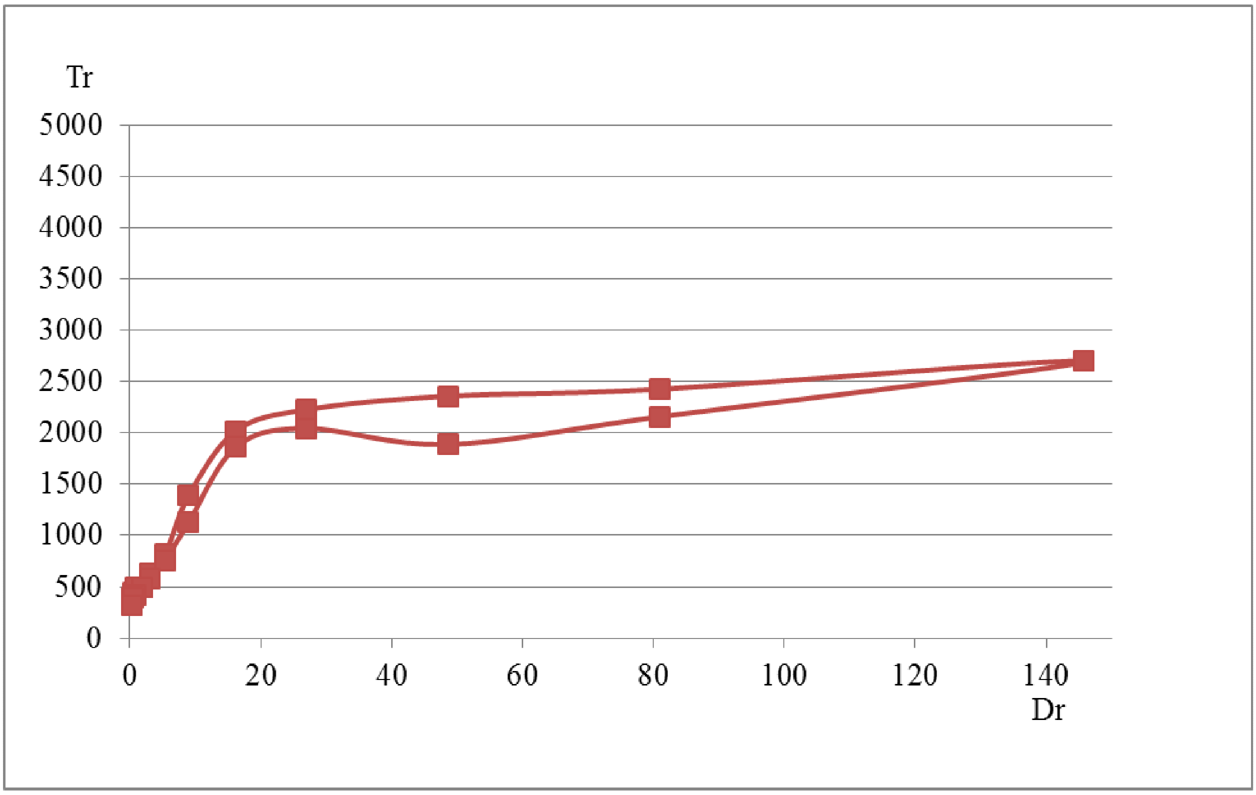

Fig. 6. The dependence of the ointment base № 3 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 34 °C

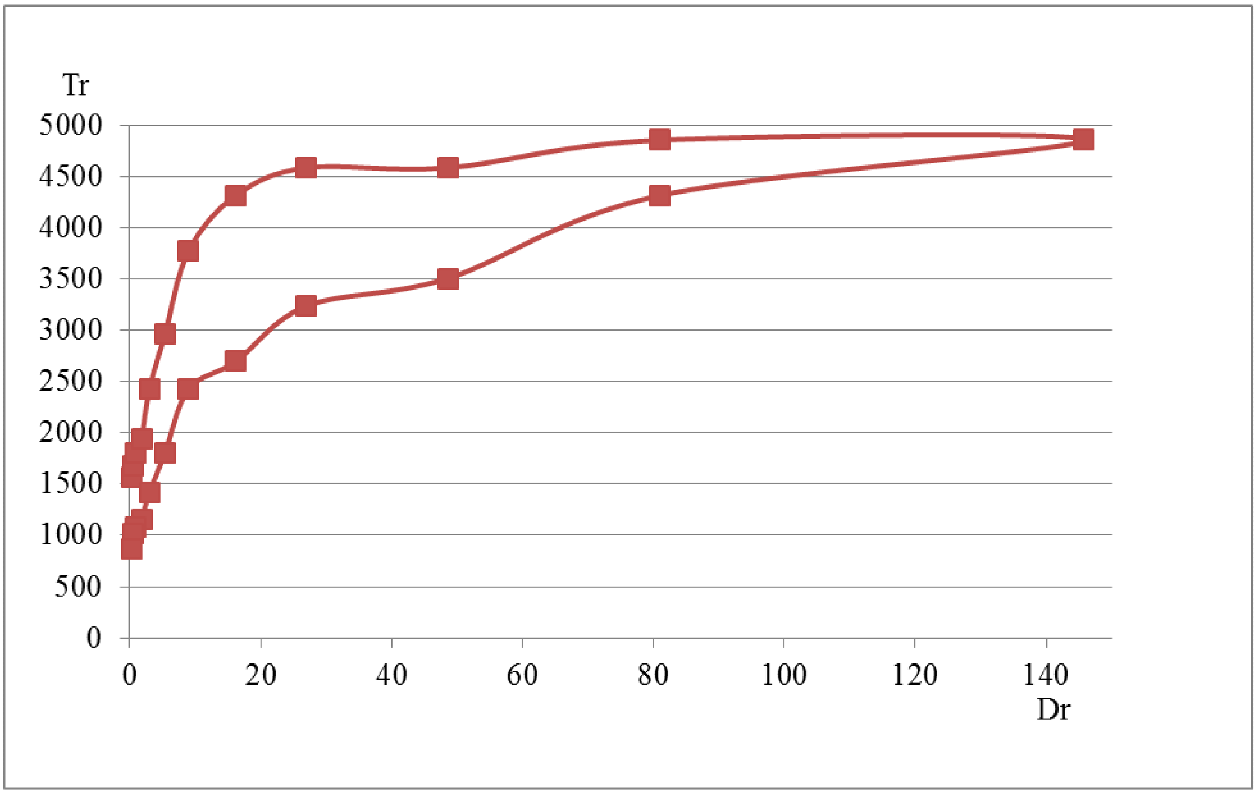

Fig. 7. The dependence of the ointment base № 4 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 20 °C

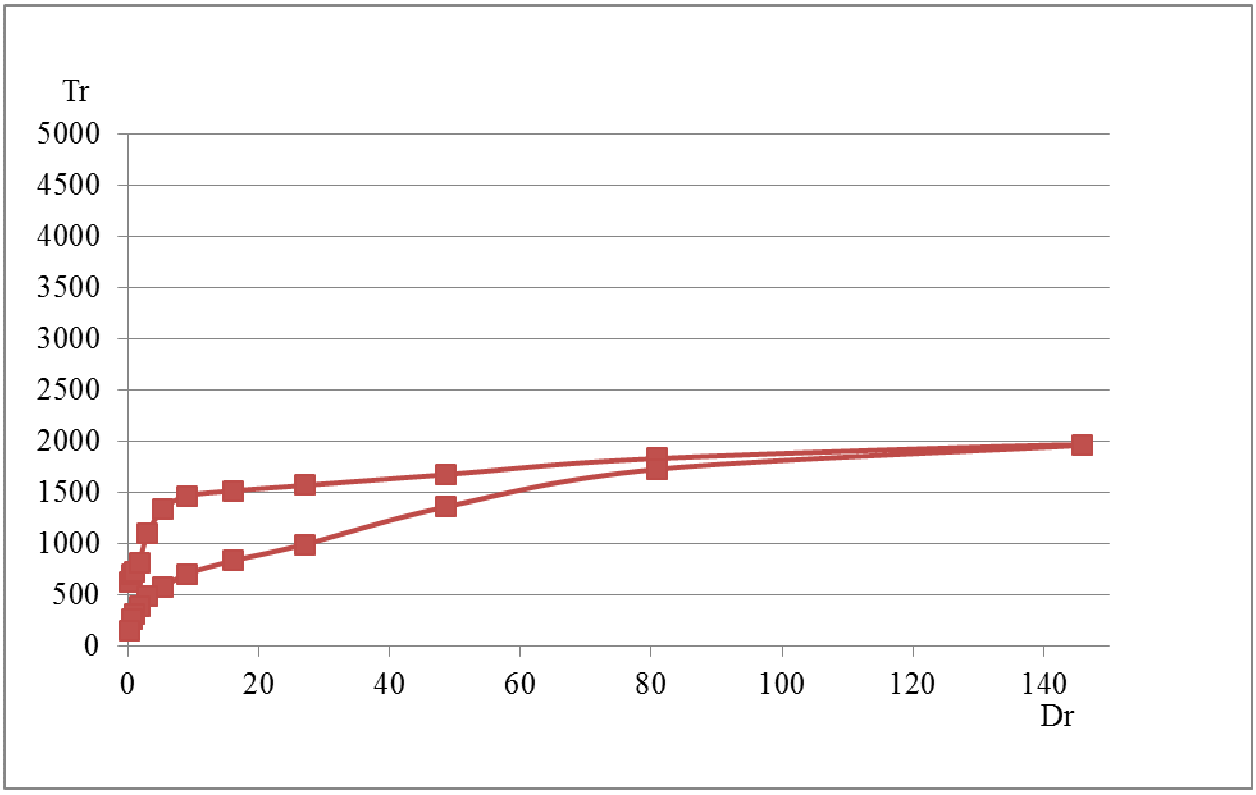

Fig. 8. The dependence of the ointment base № 4 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 34 °C

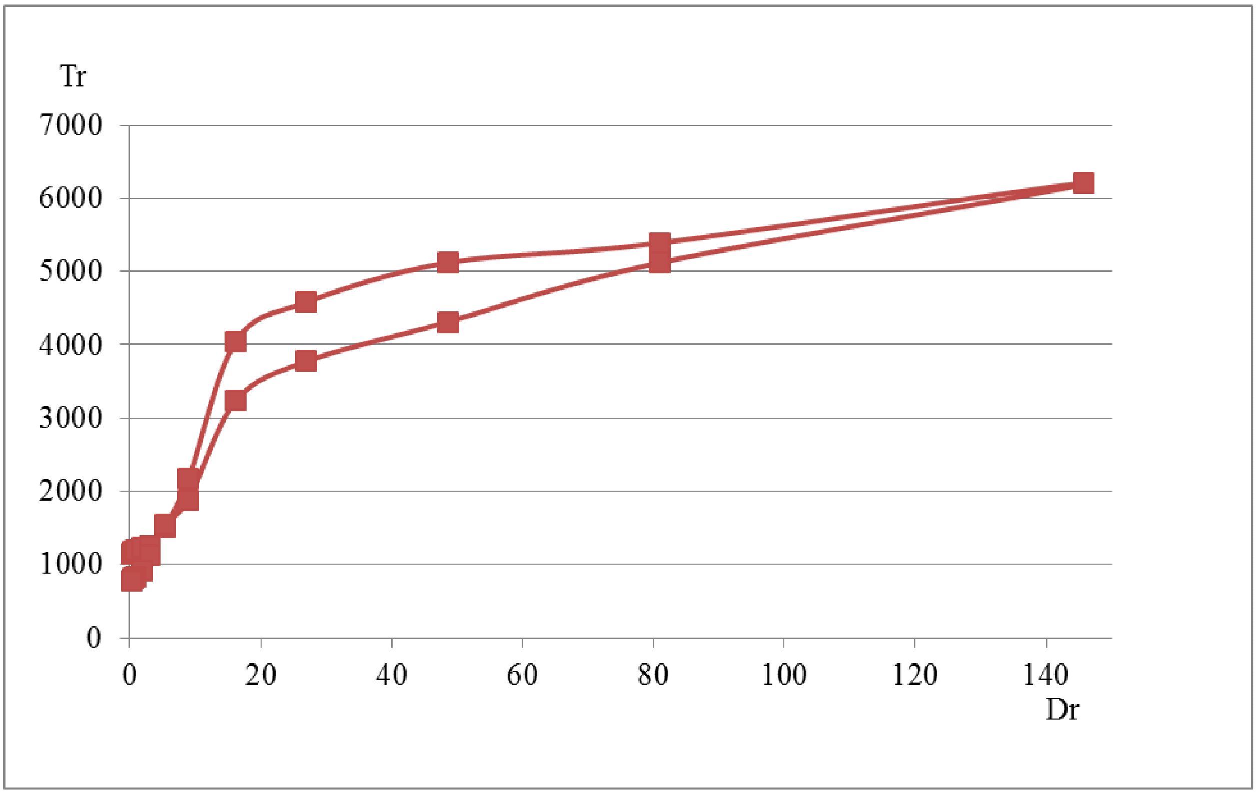

Fig. 9. The dependence of the ointment base № 5 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 20 °C

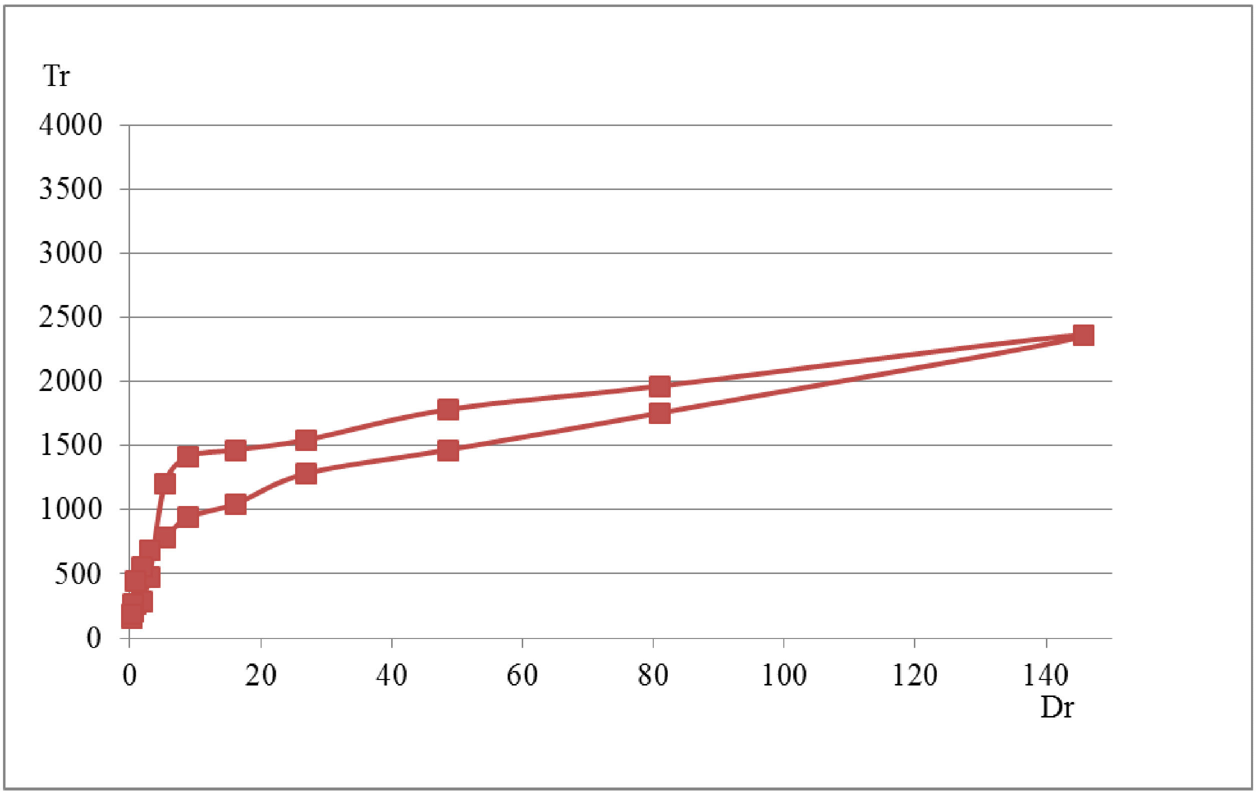

Fig. 10. The dependence of the ointment base № 5 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 34 °C

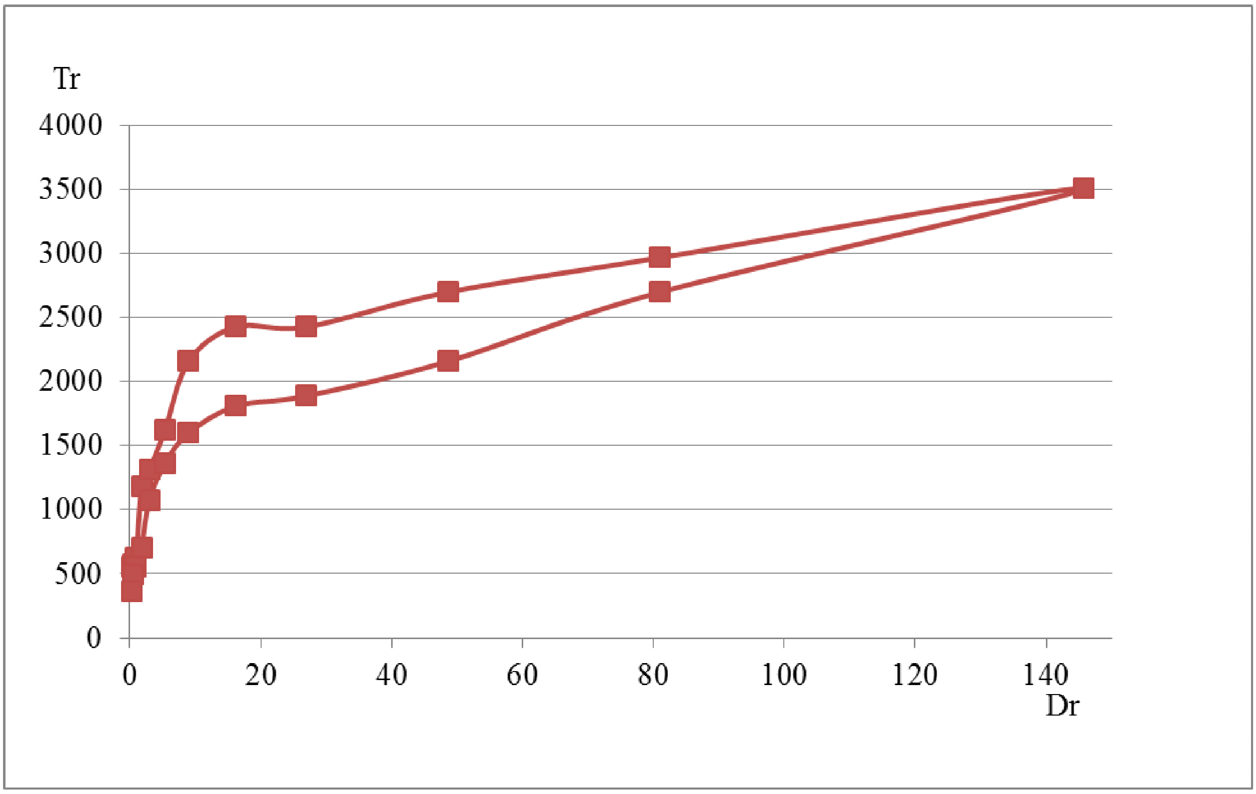

Fig. 11. The dependence of the ointment base № 6 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 20 °C

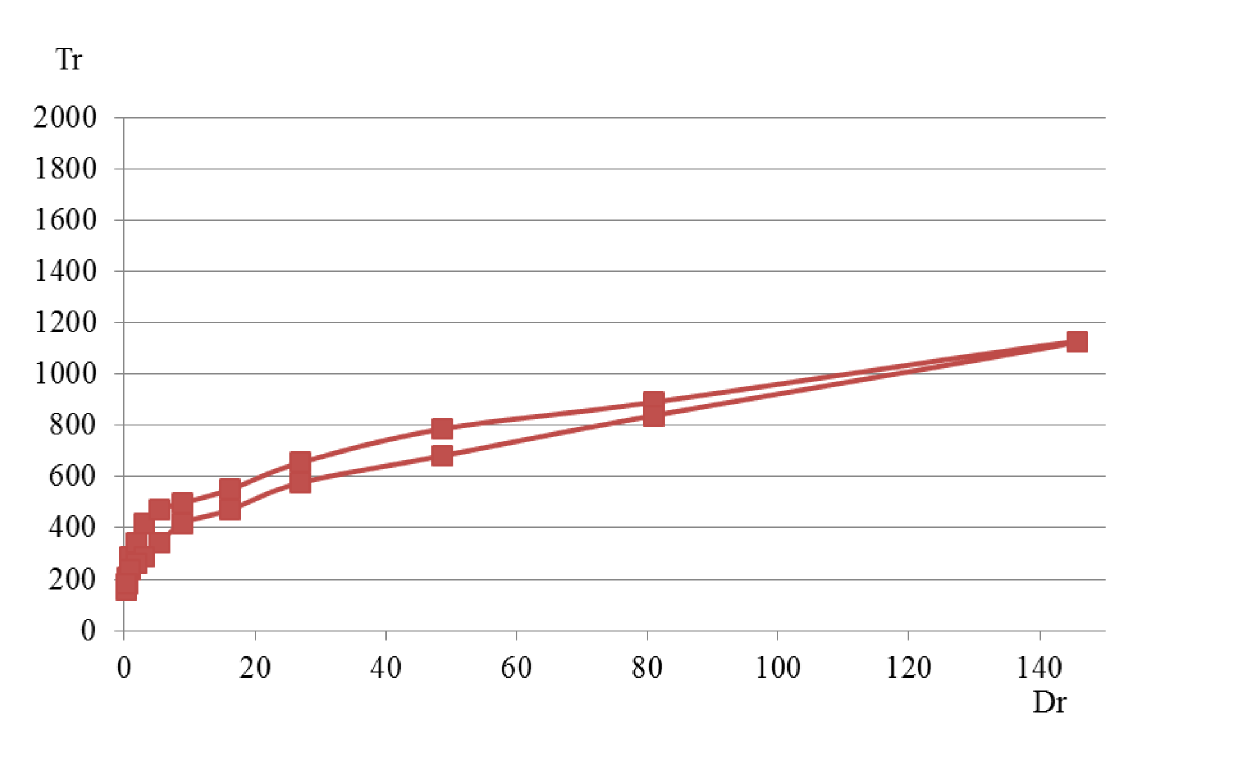

Fig. 12. The dependence of the ointment base № 6 limiting shear stress (Tr) on shear rate (Dr) at a temperature of 34 °C

In order to study thixotropic properties the curve of kinetics deformation of ointments in the coordinates «shear rate Dr - shear stress Tr» was constructed. The curves (Fig. 1-12) show significant hysteresis loops, while «rising» curve, which describes the destruction of the system, differ from the «descending» curve, which characterizes the resumption of the system, and is explained by preservation of residual deformation after a strong attenuation of the structure under the influence of earlier applied stress. Availability of the rising and descending hysteresis loop curves indicates that the investigated bases possess thixotropic properties. The presence of thixotropic properties in the test ointments characterizes satisfactory spreadability on the skin and the ability to extrusion of the tube.

At low shear rates the structure of ointments is destroyed and completely renewed (in this case, the system has the highest viscosity). With the increase in shear rate destruction of the ointment structure begins to prevail over the resumption, and the viscosity decreases. At high shear rates, the structure is completely destroyed, and the system starts to flow. As seen from the figures, all the samples of ointments have a proper degree of thixotropy.

Assessment of conducted researches allows to reveal the following. With increasing of solid fat content in ointment composition and respectively decreasing of beeswax are reduced the structural and mechanical properties of the base. The greatest thixotropy showed base with a solid fat content of 8%.

CONCLUSION

The tested ointment bases possess thixotropic properties and plasticity and belong to the class of Bingham systems. Thus ointment with solid fat content - 8%, isopropyl myristate - 60% and beeswax - 32% by its rheological characteristics superior to other formulations.

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