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INFLUENCE OF PANTHENOL, CHLORPHENESIN AND LIGNOCAINE ON THE RHEOLOGICAL PROPERTIES OF SOLIDIFIED SODIUM STEARATE-BASED STICKS(SSSS).

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ABSTRACT.

The influence of three topically active drugs, Panthenol, Chlorphenesin and Lignocaine on the rheological properties of some SSSS bases containing glycerol, propylene glycol (PG), polyethylene glycol 400 (PEG 400) or PEG 600 as humectants, was investigated using a Ferranti-Shirley cone plate viscometer, in an attempt to throw further light on the possibility of using solidified sodium stearate based sticks as topical dosage form.

-Panthenol generally lowered the static and dynamic yield values of the various investigated SSSS bases except those containing less than 17.5% PG in which these parameters increased as a result of inclusion of the drug. Thixotropic breakdown was much lower in medicated sticks than in the corresponding bases; PG-formulated sticks also offered an exception in this respect. Panthenol also lowered the plastic viscosity of all the investigated SSSS bases.

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-Chlorphenesin generally increased the static and dynamic yield values of PG-formulated stick bases;in presence of other humectants,these parameters were much less affected by the addition of the drug.Again,thixotropic breakdown was appreciably increased by addition of this drug to PG-formulated SSSS bases; glycerol and PEG 600-formulated stick bases reacted variably to the addition of the drug,according to humectant concentration, whereas PEG 400-formulated ones showed no significant change in their thixotropic breakdown.Chlorphenesin lowered the plastic viscosity of PG and glycerol-formulated SSSS bases and did not modify that of bases containing polyethylene glycols as humectants.

-Lignocaine generally increased the static and dynamic yield values of PG-formulated stick bases,especially at high humectant concentrations;with other humectants,these parameters were lowered to different extents due to inclusion of this medicament in the sticks.Lignocaine increased the thixotropic breakdown of PG-formulated stick bases and lowered this parameter appreciably in the case of PEG 400-formulated bases;no well defined influence of the drug on this parameter was noticed in the case of bases containing any of the two other humectants.The plastic viscosity of all investigated SSSS bases was lowered in presence of Lignocaine.

An interpretation was advanced to the observed phenomena whenever possible.

INTRODUCTION.

A previous publication considered the rheological behaviour of SSSS formulations as a function of humectant type and concentration (1);the present work investigates the influence of three topically active drugs,Panthenol,Chlorphenesin and Lignocaine, on the rheological properties of the above mentioned formulations,using a Ferranti-Shirley cone-plate viscometer,in an attempt to throw more light on the possibility of using solidified sod-stearate-based sticks as topical dosage form (2).

MATERIALS.

The samples of sticks subjected to rheological evaluation were taken from the same batches simultaneously subjected to the physical evaluations reported in a previous publication (3).

APPARATUS AND METHODS.

The same equipment and methods used in a previous work (1) were used in the present one for the rheological evaluation of the sticks.

RESULTS AND DISCUSSION.

Various SSSS bases containing glycerol,propylene glycol (PG),polyethylene glycol 400 (PEG 400) or PEG 600 as humectants were shown in a previous publication to exhibit plastic thixotropic behaviour (1);the addition of any of the investigated medicaments to such bases did not change their flow pattern but affected,interestingly,their dynamic and static yield values,extent of thixotropic breakdown and plastic viscosity.Figures 1-12 illustrate the influence of the investigated medicaments on the above mentioned rheological parameters (1,4-6).

Static Yield Value,σ_s (spur value):

-Panthenol:Figure 1 shows that the inclusion of 5% Panthenol in stick bases containing PG in concentrations between 10 and 15% increases their static yield value,whereas at 17.5% humectant concentration this parameter is practically unaffected;at 20%

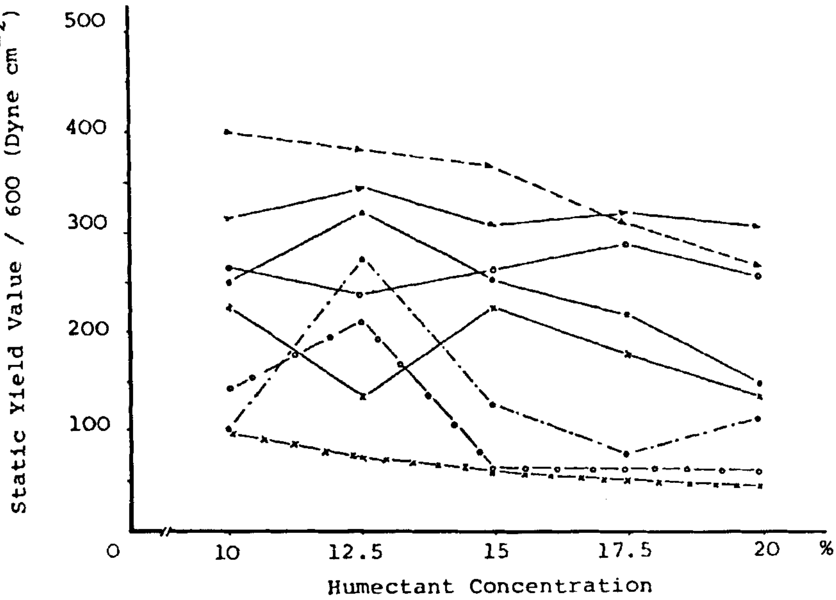

FIGURE 1
Influence of Panthenol (5%) on the Static Yield Value of the Selected Stick Bases.Key:

●——●	Glycerol-formulated Base	
●- - -●	" " "	+Medicament
▲——▲	PG-formulated Base	
▲- - -▲	" " "	+Medicament
x——x	PEG 400-formulated Base	
x–x–x–x	" " "	+Medicament
o——o	PEG 600- " "	
o–o–o–o	" " "	+Medicament

PG concentration,,the static yield value of the base stick is slightly lowered by the drug.On the other hand, the addition of the medicament to stick bases containing glycerol or any of the two investigated polyethylene glycols,generally tends to lower their static yield value.

-Chlorphenesin:Figure 2 shows that the static yield value of PG-formulated sticks increases in presence of the drug over the whole range of humectant concentrations;PEG 400-formulated stick bases do not seem to be affected.On the other hand,the addition of Chlorphenesin to glycerol or PEG 600-formulated stick bases

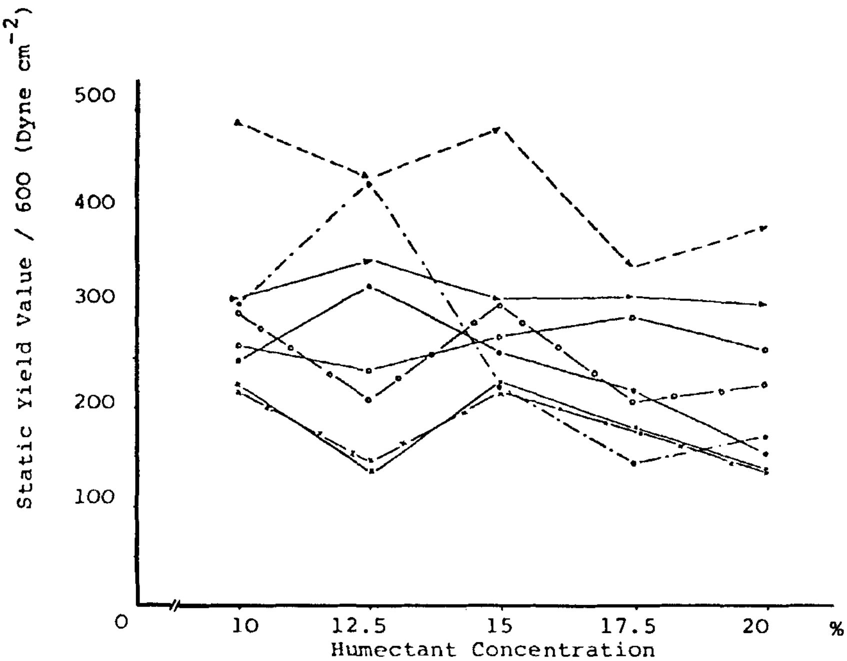

FIGURE 2
Influence of Chlorphenesin (1%) on the Static Yield Value of the Selected Stick Bases.Key:as fig. 1.

alters their static yield value positively or negatively according to humectant concentration.

-Lignocaine:Figure 3 shows that the inclusion of 2% Lignocaine in PG-formulated SSSS bases containing more than 12.5% humectant raises their static yield value.On the other hand,the addition of the medicament to PEG 400 formulated SSSS bases lowers this parameter appreciably;this lowering is also noticed,but to a lesser extent,in the case of glycerol formulated bases.The addition of Lignocaine to PEG 600-formulated SSSS bases alters their static yield value positively or negatively depending on humectant concentration,although to a lesser extent than in the case of Chlorphenesin.

Dynamic Yield Value,σ_d:

As shown in figures 4-6,the dynamic yield value-concentration curves for the various investigated sticks display a beha-

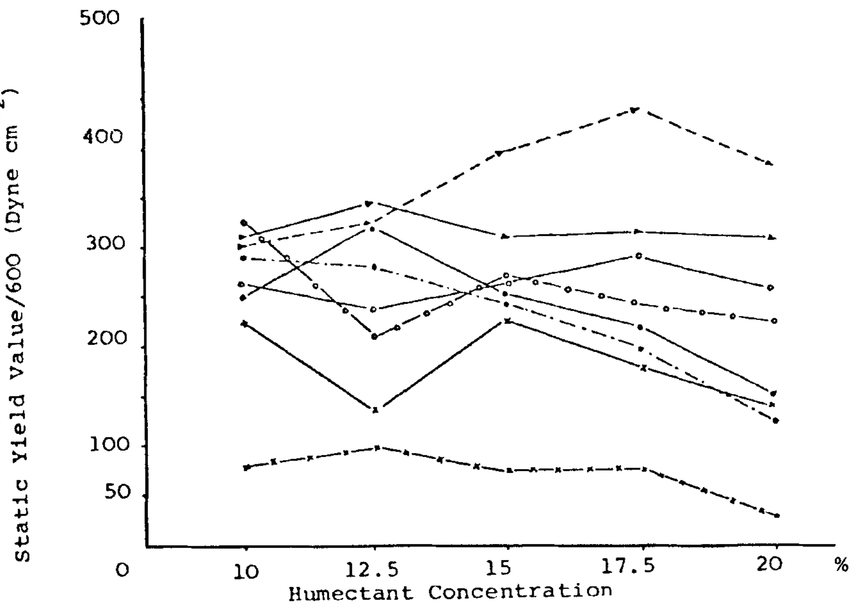

FIGURE 3
Influence of Lignocaine (2%) on the Static Yield Value of the Selected Stick Bases.Key:as fig. 1.

viour that is almost similar to that of the corresponding static yield value-concentration curves (figures 1 to 3).This suggests that both parameters are,to a great extent,influenced by the same basic factors resulting in the rheological behaviour of the different systems.

Area of Hysteresis Loop:

-Panthenol:Figure 7 shows that the addition of Panthenol to SSSS bases containing PG generally decreases their thixotropic breakdown;however,at 15% humectant concentration,this parameter does not seem to be affected.On the other hand,the addition of Panthenol to any of the other investigated bases reduces their thixotropic breakdown appreciably.

-Chlorphenesin:Figure 8 shows that the addition of Chlorphenesin to SSSS bases containing PG increases their thixotropic breakdown to a great extent.The same thing happens with PEG

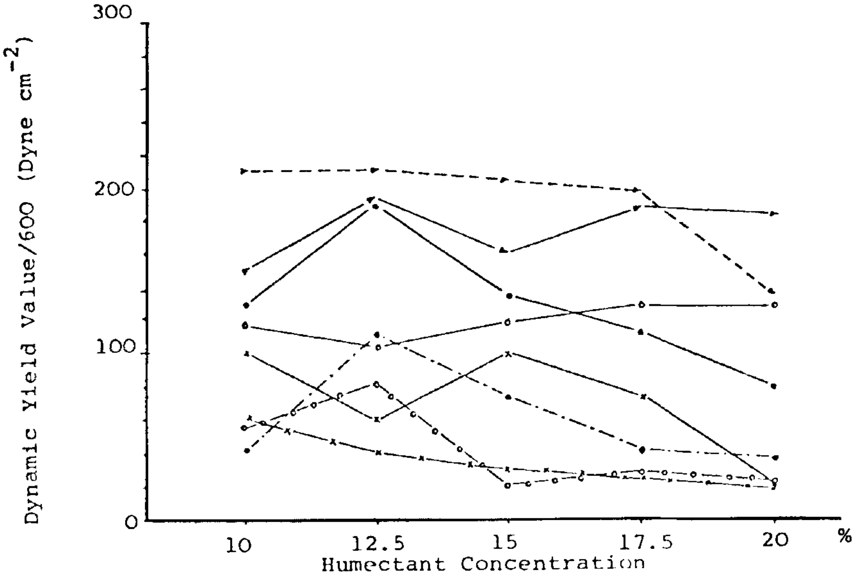

FIGURE 4
Influence of Panthenol (5%) on the Dynamic Yield Value of the Selected Stick Bases.Key:as fig. 1.

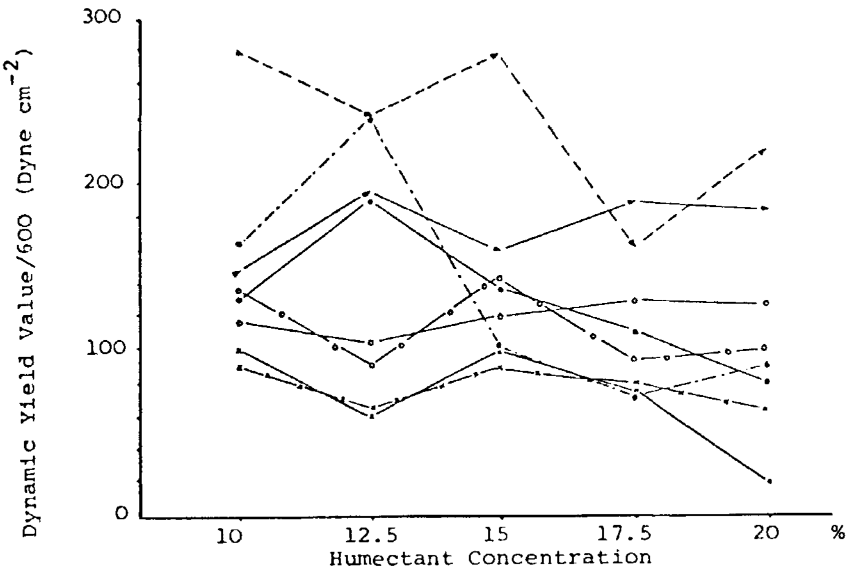

FIGURE 5
Influence of Chlorphenesin (1%) on the Dynamic Yield Value of the Selected Stick Bases.Key:as fig. 1.

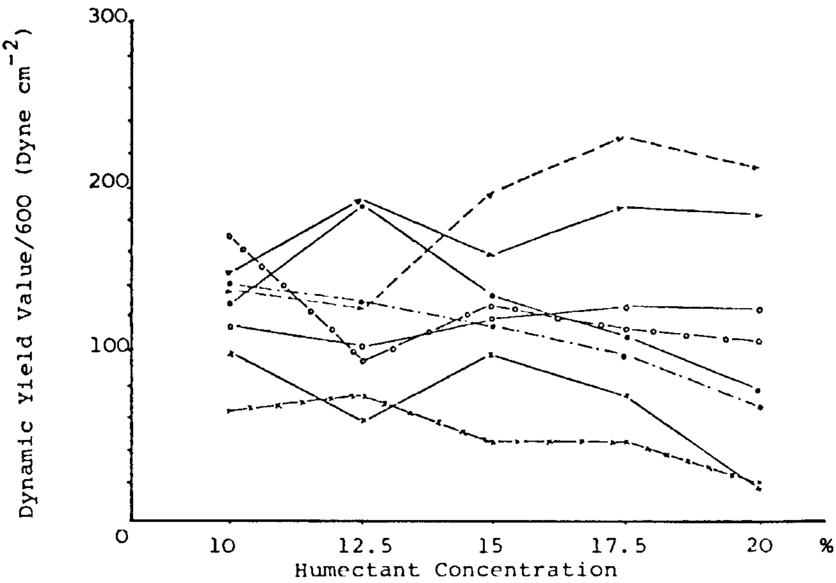

FIGURE 6
Influence of Lignocaine (2%) on the Dynamic Yield Value of the Selected Stick Bases.Key:as fig. 1.

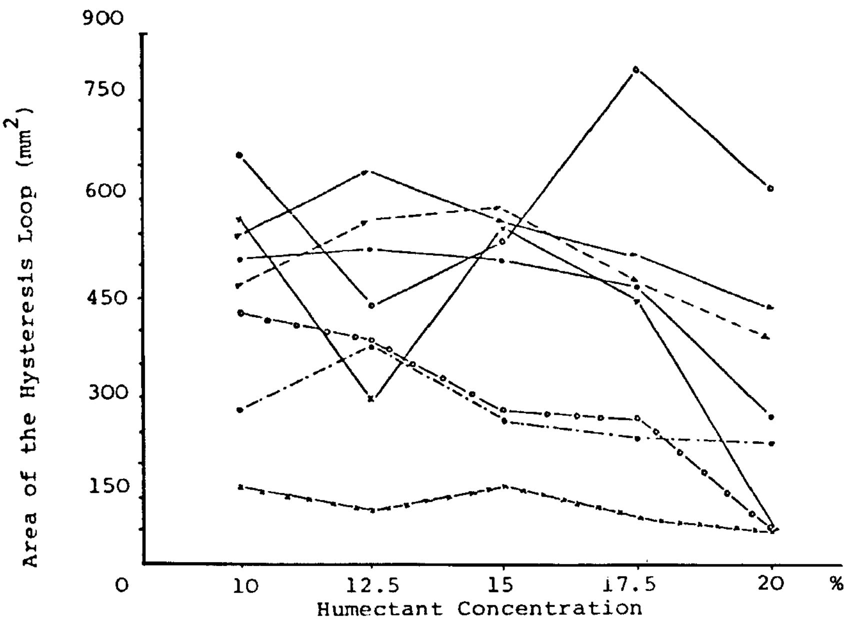

FIGURE 7
Influence of Panthenol (5%) on the Area of the Hysteresis Loop of the Selected Stick Bases.Key:as fig. 1.

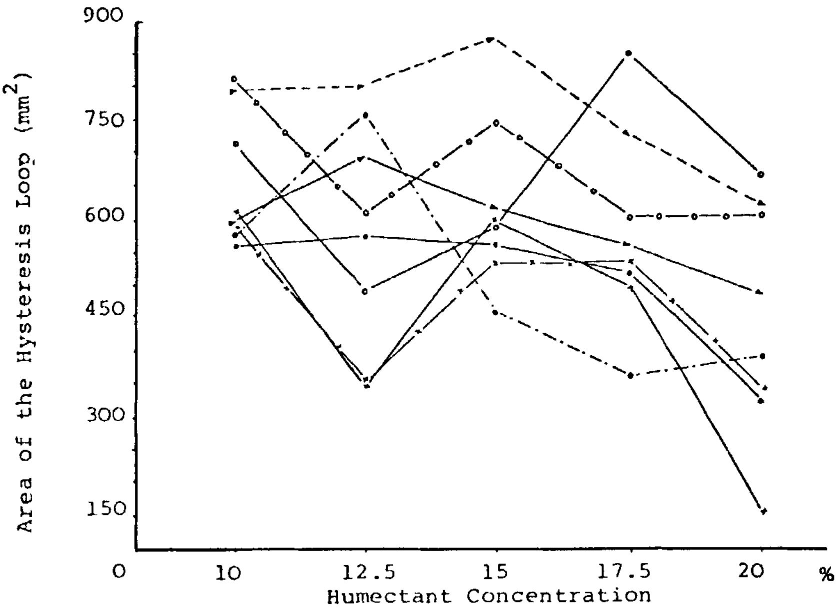

FIGURE 8
Influence of Chlorphenesin (1%) on the Area of the Hysteresis Loop of the Selected Stick Bases.Key:as fig. 1.

600 and glycerol-formulated sticks ,especially at lower humectant concentration;at higher concentrations,the reverse takes place.On the other hand,no or very limited variations in thixotropic breakdown take place on addition of Chlorphenesin to PEG 400-formulated SSSS bases.

-Lignocaine:Figure 9 shows that a pronounced increase in thixotropic breakdown takes place as a result of the addition of Lignocaine to PG-formulated SSSS bases;the reverse is noticed with those sticks formulated with PEG 400 which,besides,showed signs of physical deterioration.Glycerol-formulated stick bases show the least variation in thixotropy as a result of addition of the medicament.On the other hand,the addition of the drug to PEG 600-formulated stick bases alters their thixotropy positively or negatively according to humectant concentration.

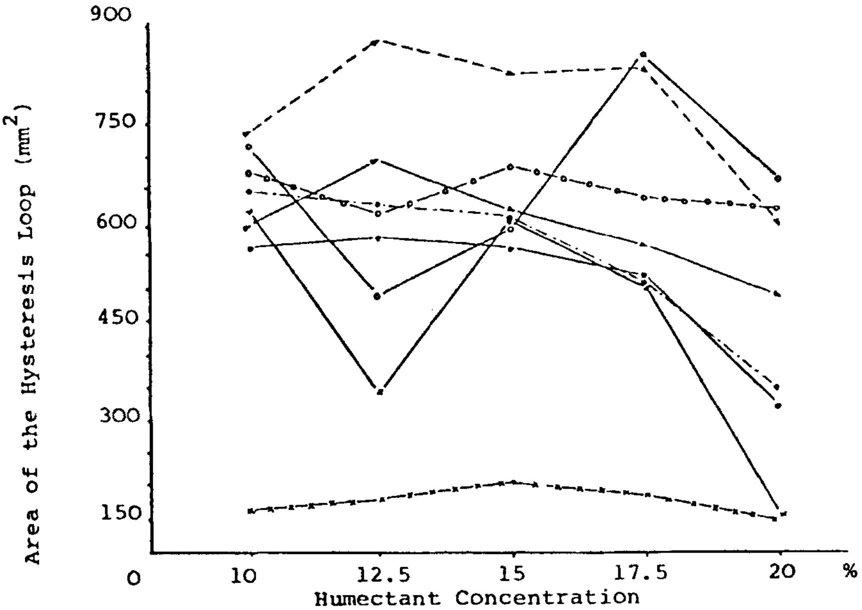

FIGURE 9
Influence of Lignocaine (2%) on the Area of the Hysteresis Loop of the Selected Stick Bases.Key:as fig. 1.

Plastic Viscosity:

-Panthenol:Figure 10 shows that the addition of Panthenol to any of the investigated bases generally lowers its plastic viscosity;this is particularly obvious in the case of PG -formulated bases.

-Chlorphenesin:Figure 11 shows that the plastic viscosity of glycerol or PG-formulated SSSS bases is generally lowered by the addition of the medicament.In presence of PEG 400,no significant variation in this parameter takes place as a result of the addition of the drug,except a slight lowering above 15% humectant concentration.On the other hand,adding the drug to PEG-formulated stick bases alters their plastic viscosities positively or negatively according to humectant concentration.

-Lignocaine:As figure 12 shows,the addition of 2% Lignocaine to SSSS bases reduces their plastic viscosities;a pronounced

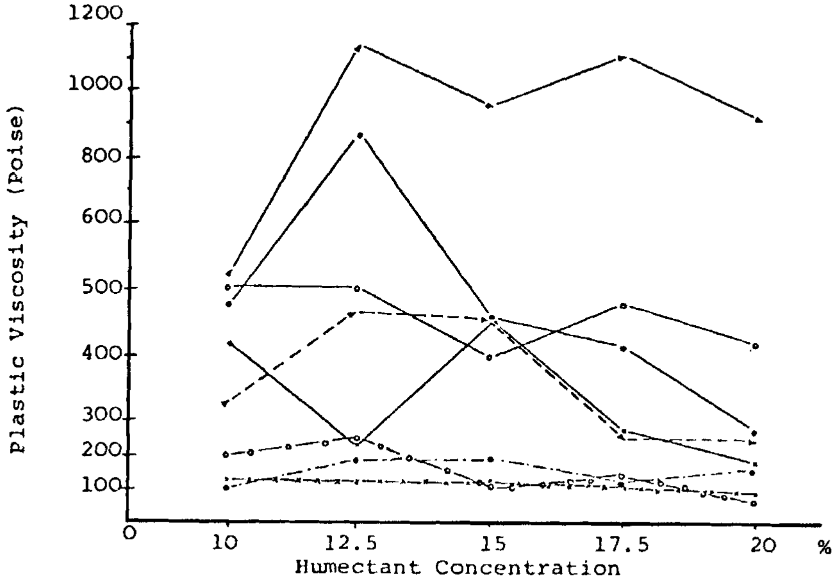

FIGURE 10
Influence of Panthenol (5%) on the Plastic Viscosity of the Selected Stick Bases.Key:as fig. 1.

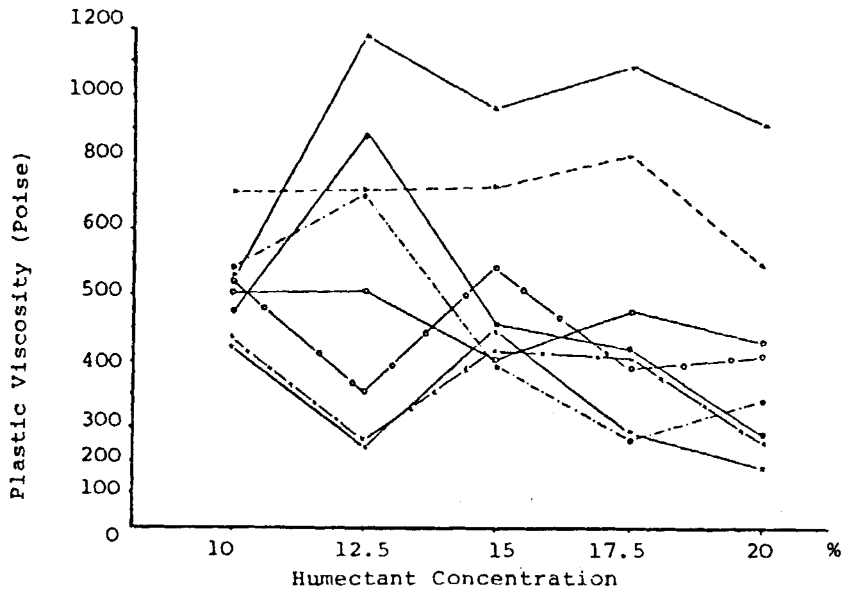

FIGURE 11
Influence of Chlorphenesin (1%) on the Plastic Viscosity of the Selected Stick Bases.Key:as fig. 1.

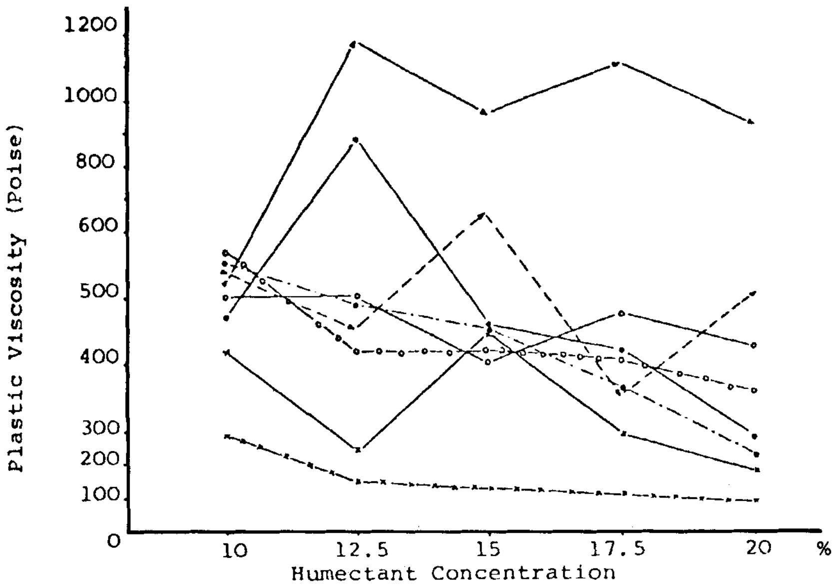

FIGURE 12
Influence of Lignocaine (2%) on the Plastic Viscosity of the Selected Stick Bases.Key:as fig. 1.

lowering is noticed in the case of PG-formulated bases and a slight one in the case of polyethylene glycol-formulated ones.

The change in the rheological picture of the bases due to addition of the investigated medicaments,reflects the influence of the latter on gel structure.Considering the structure of SSSS bases (7,8) and the physical properties of the three investigated medicaments (9-11),Panthenol would be expected to dissolve both in the aqueous and organic layers of the soap micelles,whereas Chlorphenesin and Lignocaine would dissolve most probably in the organic layer.

At low PG concentrations,Panthenol contributes to increasing the yield value of the preparation probably through dissolution in the aqueous layer and decreasing the hydrogen bonding interrupting effect of the ethanol molecules liable to be present there (7,12) and weakening water-soap binding;this effect is opposed by the tendency of Panthenol to dissolve the sodium stearate network (9).However,the net result of these two processes seems to be in favour of the first one at low PG concentrations;as PG concentration increases,the very limited aqueous layer (7) seems to be saturated with the humectant and on addition of Panthenol to the SSSS base,its solubilizing effect on the soap network probably predominates thereby decreasing the number of points of attachment (13),and the yield value of the base decreases.As the structure is sheared and secondary bonds are broken,the solubilizing effect of the medicament on the network becomes obvious;a lower plastic viscosity being thus noticed in presence of the drug.In the case of glycerol,PEG 400 and PEG 600-formulated bases,the solubilizing effect of the medicament seems to predominate and hence the observed lower yield values and plastic viscosities.The lowering in plastic viscosity of the bases in presence of Panthenol reflects the good film spreading characteristics and improved glide properties on application on the skin with reasonable pressure (4,14).

Analogous changes in the structure of the liquid crystalline solutions of the stick bases might probably account for the variations in their rheological properties as a result of the presence of Chlorphenesin or Lignocaine (7,12).

CONCLUSIONS.

1.Panthenol generally lowers the static and dynamic yield values of the various investigated SSSS bases except those containing less than 17.5% PG.Thixotropic breakdown is much lower in Panthenol sticks than in the corresponding bases;PG medicted sticks also offer an exception in this respect.Panthenol also lowers the plastic viscosity of all the investigated SSSS bases.

2.Chlorphenesin generally increases the static and dynamic yield values of PG-formulated stick bases;in presence of other humectants these parameters are much less affected by the addition of the drug.Again,thixotropic breakdown is appreciably increased by addition of this drug to PG-formulated SSSS bases; glycerol and PEG-600 formulated SSSS bases react variably to the addition of Chlorphenesin according to humectant concentration,whereas PEG 400-formulated ones show no significant change in their thixotropic breakdown.Chlorphenesin lowers the plastic viscosity of PG and glycerol-formulated SSSS bases and does not modify that of bases containing polyethylene glycols as humectants.

3.Lignocaine generally increases the static and dynamic yield values of PG-formulated stick bases,especially at high humectant concentrations;with other humectants,these parameters are lowered to different extents due to inclusion of this medicament in the stick bases.Lignocaine increases the thixotropic breakdown of PG-formulated stick bases and lowers this parameter appreciably in the case of PEG 400-formulated ones;no well defined influence of the drug on this parameter is noticed in the case of bases containing any of the other two humectants.The plastic viscosity of all investigated SSSS bases is lowered in presence of Lignocaine.

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