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INFLUENCE OF PANTHENOL, CHLORPHENESIN AND LIGNOCAINE ON THE PHYSICAL CHARACTERISTICS OF SOLIDIFIED SODIUM STEARATE-BASED STICKS(SSSS)

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ABSTRACT

Cosmetic sticks provide many consumer advantages over the more readily used aerosol sprays, creams and lotions. In view of the many advantages offered by solidified sodium stearate-based sticks (SSSS), a program was set up to evaluate them as potential bases for the inclusion of topically active medicaments. The present publication elucidates the influence of Panthenol, Chlorphenesin and Lignocaine on the main physical characteristics of some SSSS bases, including their disintegration time, hardness, penetrability, softening point, yield by abrasion and rate of drying by evaporation. The investigated SSSS bases contained glycerol, propylene glycol (PG), polyethylene glycol 400 (PEG 400) or PEG 600 as humectant.

-The disintegration time of the studied bases was generally lowered by the three medicaments; however, glycerol or PG-formulated stick bases had their disintegration time slightly prolonged or unaffected by the addition of Chlorphenesin or Lignocaine;

-Panthenol generally lowered the hardness of SSSS bases but the least variation in this parameter was noticed with PG bases; hardness was generally increased with Chlorphenesin or Lignocaine, but to a lesser extent with the latter;

-generally speaking, Panthenol markedly increased the penetrability of the investigated stick bases; Chlorphenesin and Lignocaine did the same thing but to a lesser extent;

-the softening point of SSSS bases was generally lowered in presence of Panthenol or Lignocaine; Chlorphenesin did not generally affect the softening point of the stick bases; anyhow, the softening point of the investigated medicated sticks moved within the limits of safety, as far as the resistance to handling and storage in areas with occasional hot summers is concerned;

-Panthenol appreciably increased the yield by abrasion of all investigated bases; Lignocaine and Chlorphenesin did not appreciably influence this parameter except in the case of PEG 400 bases where the yield was markedly increased in presence of Lignocaine;

-the rate of drying of all the investigated stick bases was greatly lowered on addition of Panthenol; Chlorphenesin and Lignocaine affected this parameter to a much lesser extent.

INTRODUCTION

There is renewed interest in the use of sticks for skin treatment. In this regard, they provide effective moisturizing so necessary for the protection of the skin (1). Costmetic sticks provide many consumer advantages over the more readily used aerosol sprays, creams and lotions. In view of the many advantages offered by SSSS(2,3), a program was set up to evaluate them as potential bases for the inclusion of topically active drugs (3). Two previous publications have dealt with the basic physical and rheological properties of these bases as a function of humectant type and concentration (4,5); the present work and the

next three ones in this series study the formulation of medicated SSSS containing three model drugs commonly applied topically as ointments, creams or solutions namely, Panthenol (healing agent) (6-9), Chlorphenesin (antibacterial, antifungal and antitrichomonal agent) (10) and Lignocaine (local anaesthetic) (11-14).

Generally speaking, medicaments to be incorporated in SSSS bases must comply with the following requirements:

-physically and chemically compatible with the base ingredients;

-essentially soluble in alcohol and/or the types of polyols used;

-pharmacologically effective in comparatively low concentrations;

-applicable in the stick base with smooth rubbing without any discomfort to the user or any skin irritation (15,16);

-of low toxicity;

-adequately released from the base of this type of dosage form (17,18).

The objective of the present publication was to elucidate the influence of each of the incorporated medicaments on the main physical characteristics of SSSS bases, including their disintegration time, hardness, penetrability, softening point, yield by abrasion and rate of drying by evaporation (4).

MATERIALS

Formulae I-V, shown in Table 1, prepared with the selected humectants as mentioned in a previous publication (4), were used as the SSSS bases in which the chosen medicaments were included.

Pure samples of the following medicaments were used:

-D-Panthenol, from Hoffmann-Laroche, Switzerland.

-Chlorphenesin (B.P.), from B.H.D., London, England.

-Lignocaine (Lidocaine) (U.S.P.), from Dotto-Bonapace, Milano, Italy.

Table 1
Composition of Basic SSSS Formulae

Formula	Stearic Acid(%)	NaOH (%)	Deionized Water(%)	Humectant (%)	Alcohol 96% (%)
I	5.22	0.78	2.00	10.00	82.00
II	5.22	0.78	2.00	12.50	79.50
III	5.22	0.78	2.00	15.00	77.00
IV	5.22	0.78	2.00	17.50	74.50
V	5.22	0.78	2.00	20.00	72.00

APPARATUS

The same equipment used in previous publications was used for the preparation and evaluation of the investigated sticks (4).

PREPARATION OF THE STICKS

Medicated SSSS were prepared by dissolving the specified quantity of each medicament in the previously prepared SSSS base. These bases were prepared according to the procedure described before (4), using glycerol, propylene glycol (PG), polyethylene glycol 400 (PEG 400) or PEG 600 as humectants (Table 1).

Medicated sticks were prepared from the bases by weighing the specified amount of medicament in an Erlenmeyer flask and adding to it the specified amount of molten SSSS base; the flask and its contents were heated on a water bath at 60°, after fitting a reflux condenser, stirring slowly and continuously until complete dissolution of the medicament; the whole was left to cool to 55° before moulding (4).

ASSESSING THE PHYSICAL PROPERTIES OF THE STICKS

The prepared sticks were left at room temperature for at least 48 hours before any of the following tests were performed: disintegration time, hardness, penetrability, softening point, yield by abrasion and rate of drying by evaporation (4).

RESULTS AND DISCUSSION

Table 2 and Fig. 1-16 illustrate the influence of the investigated medicaments on the physical characteristics of the studied SSSS bases.

Disintegration time:

-Panthenol: Fig. 1 shows that Panthenol tends to shorten the disintegration time of all tested SSSS bases; this effect is very limited in PG- formulated bases and most pronounced in PEG 600-formulated ones.

-Chlorphenesin: Fig. 2 shows that Chlorphenesin tends to prolong the disintegration time of glycerol or PG-formulated bases and shorten that of PEG 600 containing ones, to some extent; in the case of PEG 400 bases, the medicament does n ot seem to affect this parameter appreciably.

-Lignocaine: Fig. 3 shows that only PG formulated SSSS bases find their disintegration time somewhat prolonged by addition of Lignocaine; on the other hand, this medicament tends to shorten the disintegration time of stick bases formulated with PEG 600 or PEG 400, although to a lesser extent in the latter case. The presence of Lignocaine does not seem to affect the disintegration time of glycerol-formulated bases to any significant extent.

It is noteworthy to recall in this respect that a lower disintegration time favours drug release from the base (19).

Table 2

Maximum Percent Total Weight Loss from Medicated Sticks After Three Weeks Exposure to the Test Conditions.

Stick Type	Percent Humectant Concentration																			
	10				12.5				15				17.5				20			
	*G	PG	PEG 400	PEG 600	G	PG	PEG 400	PEG 600	G	PG	PEG 400	PEG 600	G	PG	PEG 400	PEG 600	G	PG	PEG 400	PEG 600
Blank Sticks	80	84	84	82	83	78	82	82	76	77	77	77	74	75	71	75	70	74	72	73
Panthenol Sticks	56	66	67	69	76	71	73	72	63	67	53	62	56	64	45	56	63	58	52	59
Chlorphenesin Sticks	80	84	81	81	83	79	79	83	76	73	75	76	72	74	73	75	69	72	73	71
Lignocaine Sticks	80	85	81	80	82	77	80	79	72	76	74	73	74	73	74	72	68	70	66	70

*G=Glycerol

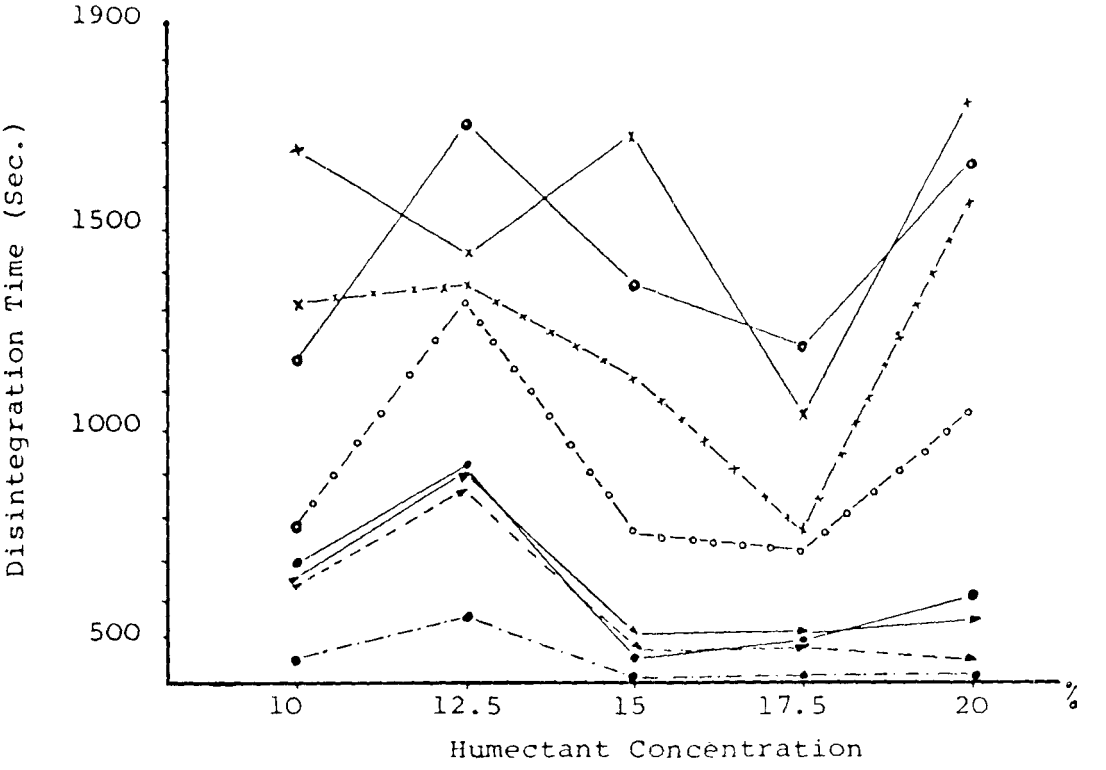

FIGURE 1

Influence of Panthenol (5%) on the Disintegration Time of the Selected Stick Bases.

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

Hardness:

-Panthenol: Fig. 4 shows that Panthenol sticks show markedly lower hardness values than the corresponding bases, except in the case of sticks containing more than 12.5% PG which show slightly higher values.

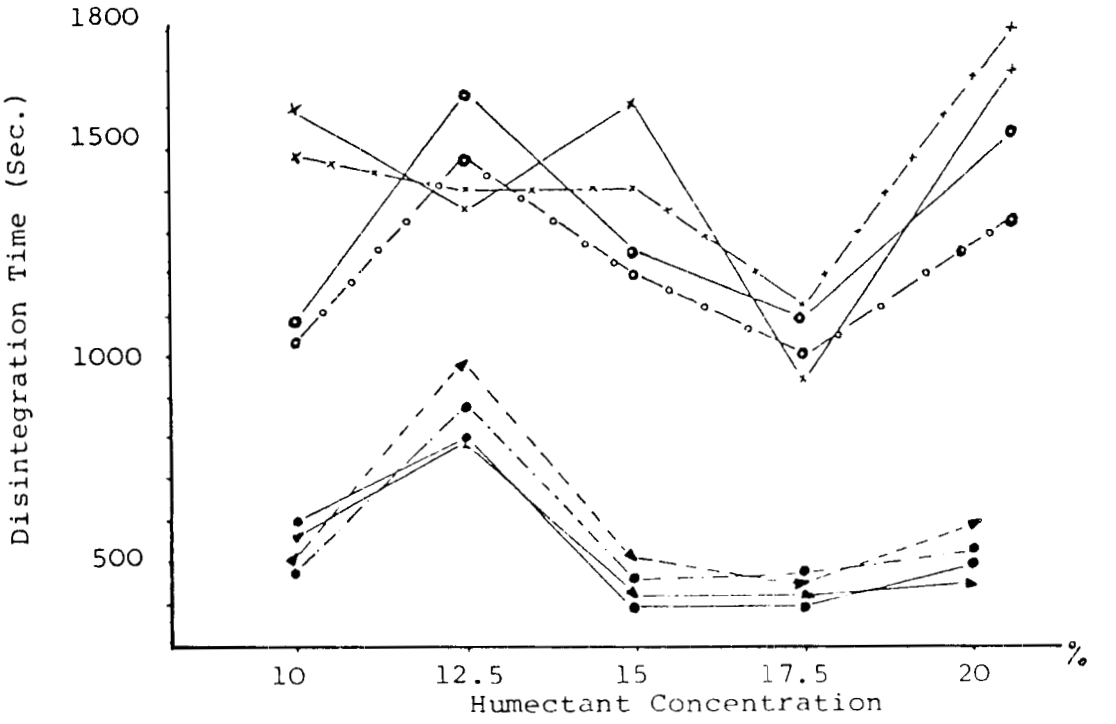

FIGURE 2
Influence of Chlorphenesin (1%) on the Disintegration Time of the Selected Sticks Bases. Key:as fig. 1.

-Chlorphenesin: Fig. 5 shows that Chlorphenesin increases appreciably the hardness of PG and glycerol-formulated SSSS bases. A similar effect is observed in the case of the polyethylene glycols but to a lesser extent.

-Lignocaine: Fig. 6 shows that only those bases with PG or glycerol generally show relatively higher hardness in presence of Lignocaine. Medicated sticks containing polyethylene glycols show hardness fluctuations as a function of humectant concentration and, although PEG 600-formulated bases seem to be slightly affected by the presence of the medicament, those containing PEG 400 generally tend to become softer.

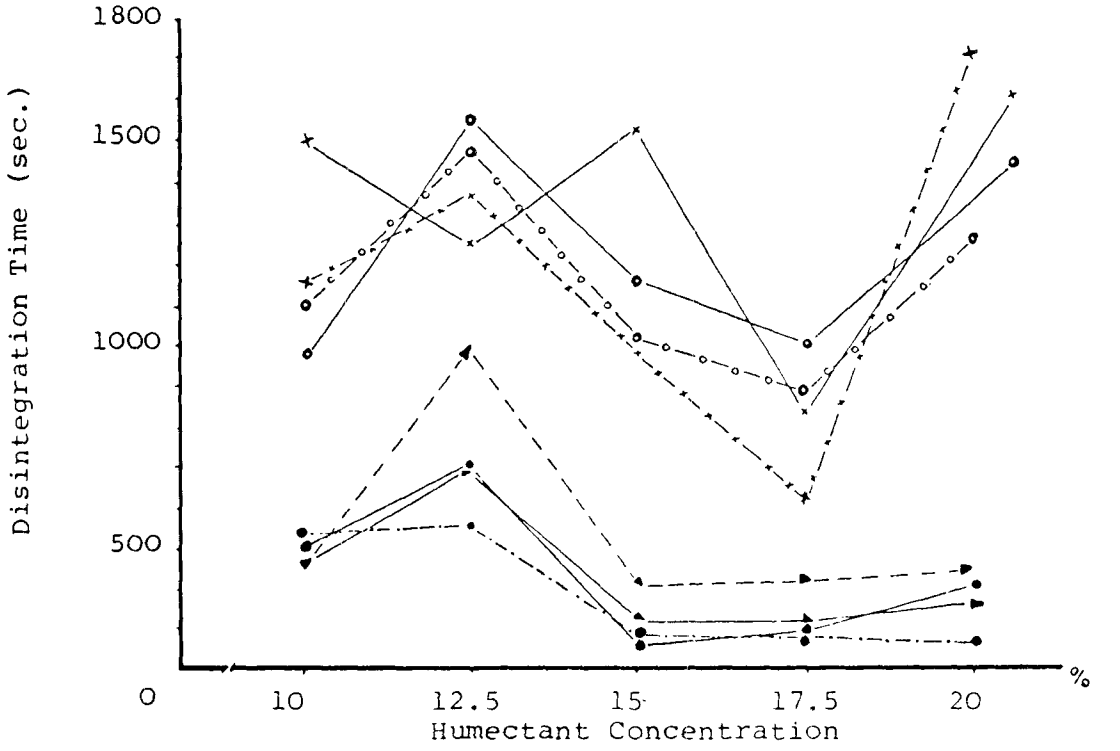

FIGURE 3
Influence of Lignocaine (2%) on the Disintegration Time of the Selected Stick Bases. Key:as fig. 1.

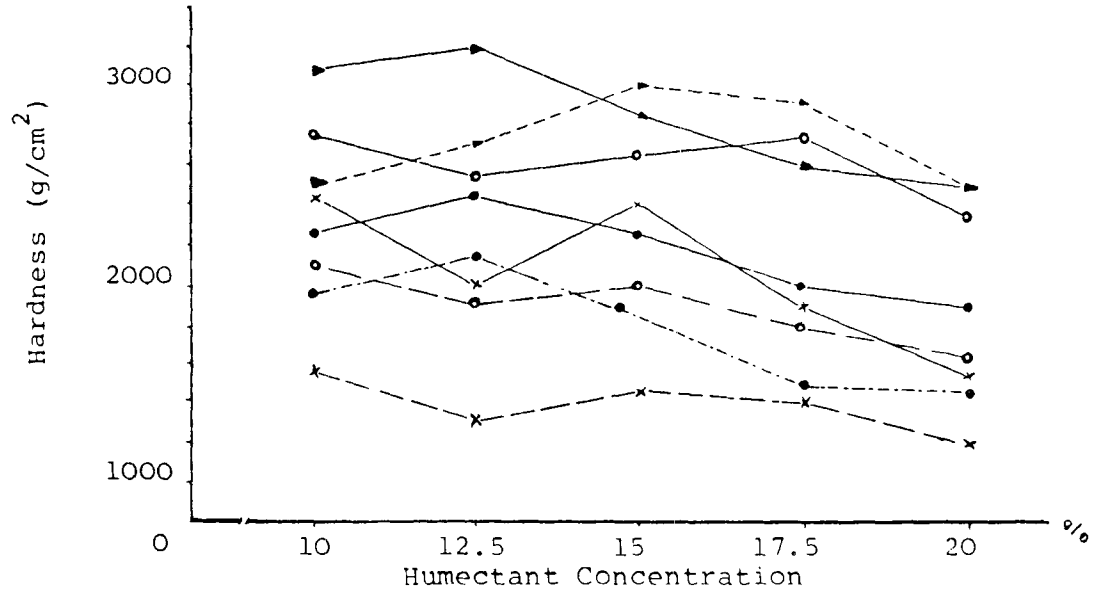

FIGURE 4
Influence of Panthenol (5%) on the Hardness of the Selected Stick Bases. Key:as fig. 1.

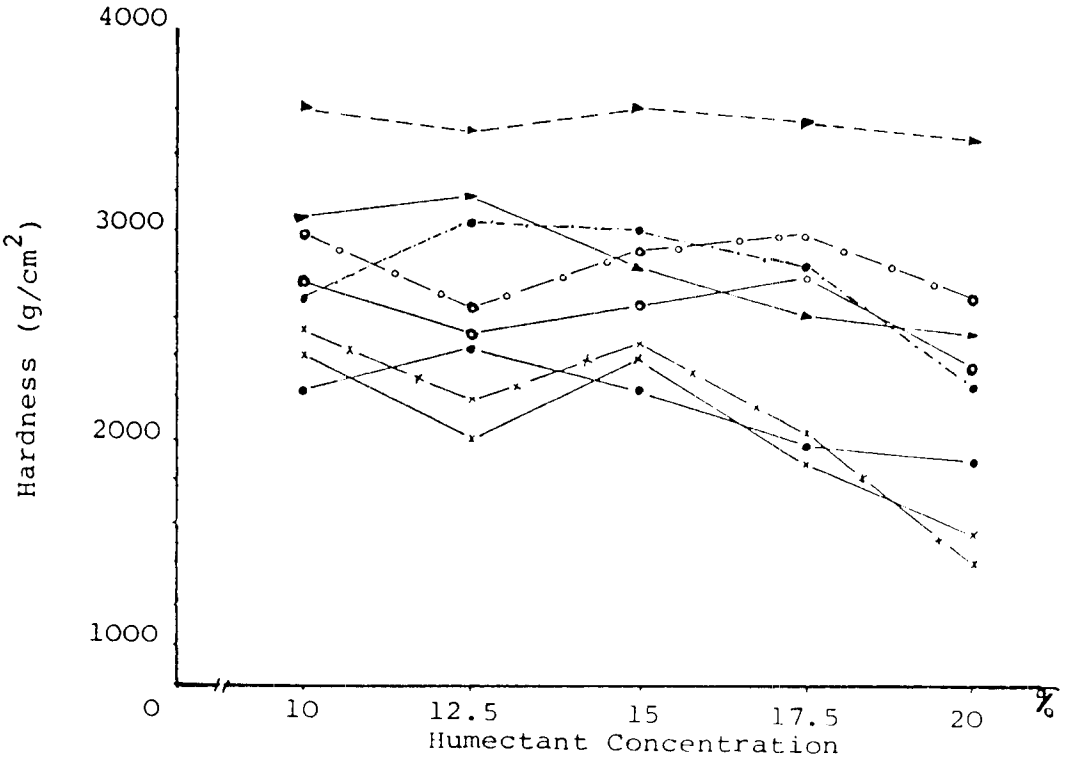

FIGURE 5
Influence of Chlorphenesin (1%) on the Hardness of the Selected Stick Bases. Key:as fig. 1.

Penetrability:

Generally speaking, the presence of any of the three investigated medicaments is shown (Figs. 7-9) to increase the penetrability of the respective stick base; however, above 15% PG, Chlorphenesin is shown to lower such a parameter.

Softening Point:

-Panthenol: Fig. 10 shows that Panthenol lowers the softening point of all the investigated SSSS bases by 2 to 5^{O}.

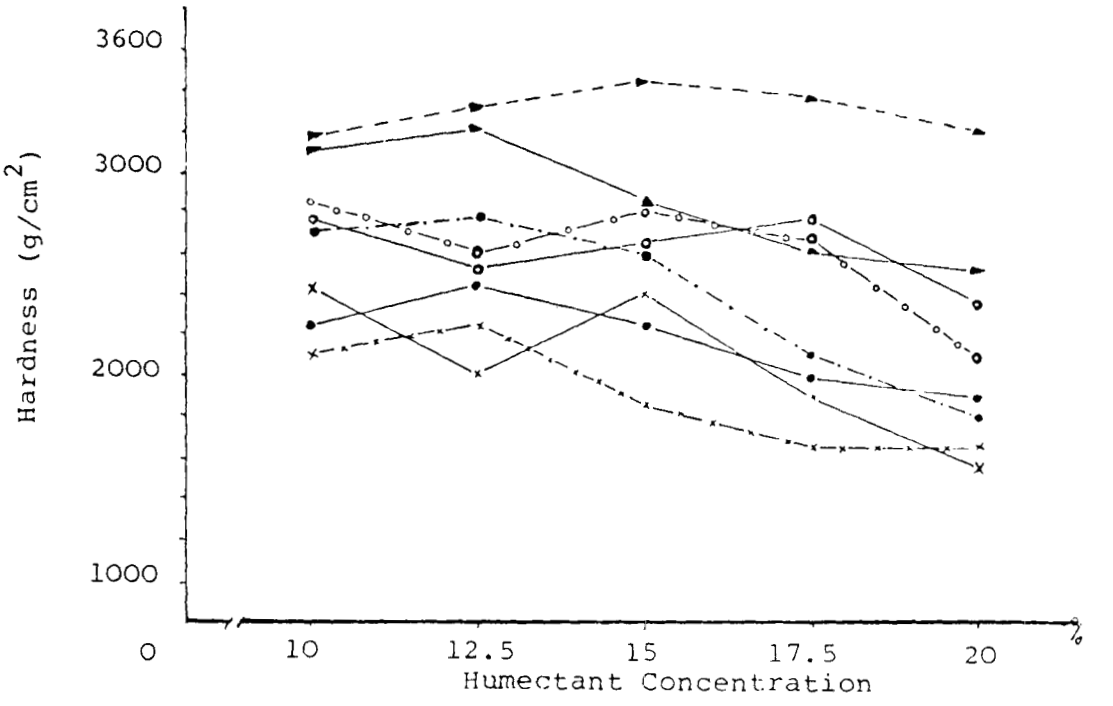

FIGURE 6
Influence of Lignocaine (2%) on the Hardness of the Selected Stick Bases. Key: as fig. 1.

-Chlorphenesin: Fig. 11 shows that this drug affects the softening point of the SSSS bases, in which it is incorporated, very slightly.

-Lignocaine: Fig. 12 shows that Lignocaine lowers the softening point of almost all tested stick bases, except in a few cases where this parameter is not affected at all; otherwise, the lowering in softening point ranges from 1-3°.

Anyhow, the softening points of the tested medicated sticks moved within the limits of safety, as far as resistance to handling and storage in areas with occasional hot summers is concerned (20,21). The variation in softening points noted in the case of medicated sticks might be a direct result of the solu-

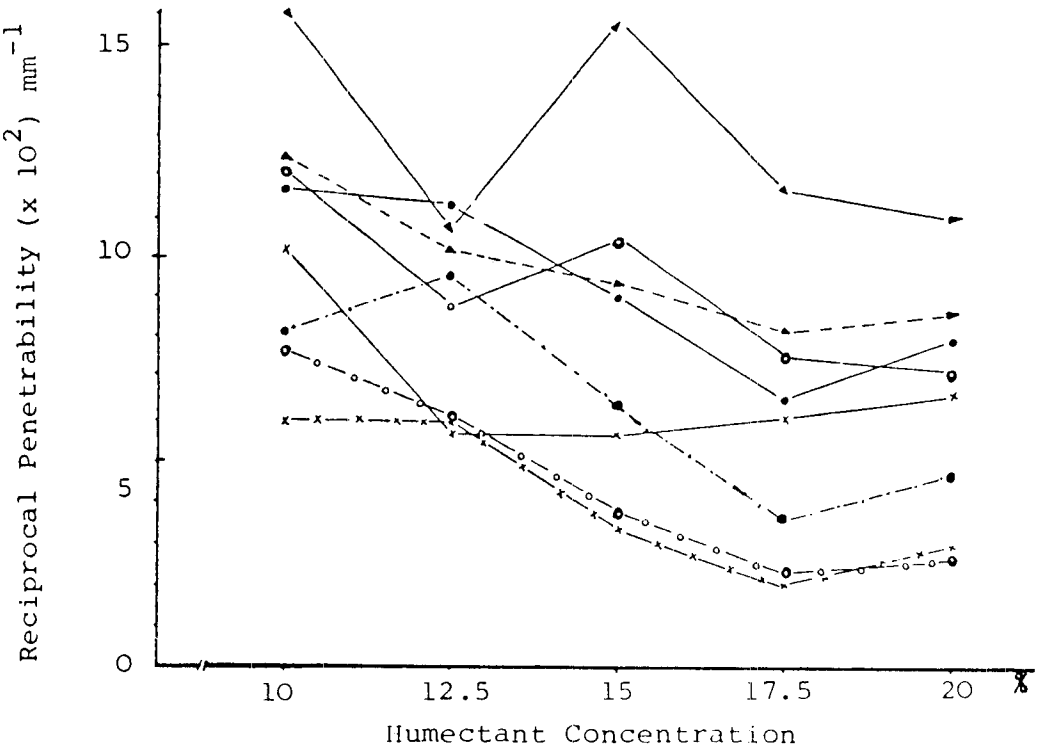

FIGURE 7
Influence of Panthenol (5%) on the Penetrability of the Selected Stick Bases. Key: as fig. 1.

bility of each specific drug in the organic or aqueous region of the soap micelles (22,23). As Winsor (22) postulated, sodium stearate based sticks, when heated, the soap alone undergoes a process of complex stepwise melting in which first the hydrocarbon chains and then the polar groups undergo progressive disordering. Over the intermediate range of temperature, hydrocarbons can be dissolved in limited amounts in the disordered hydrocarbon regions of the soap, while the polar groups of the soap largely retain their crystalline order.

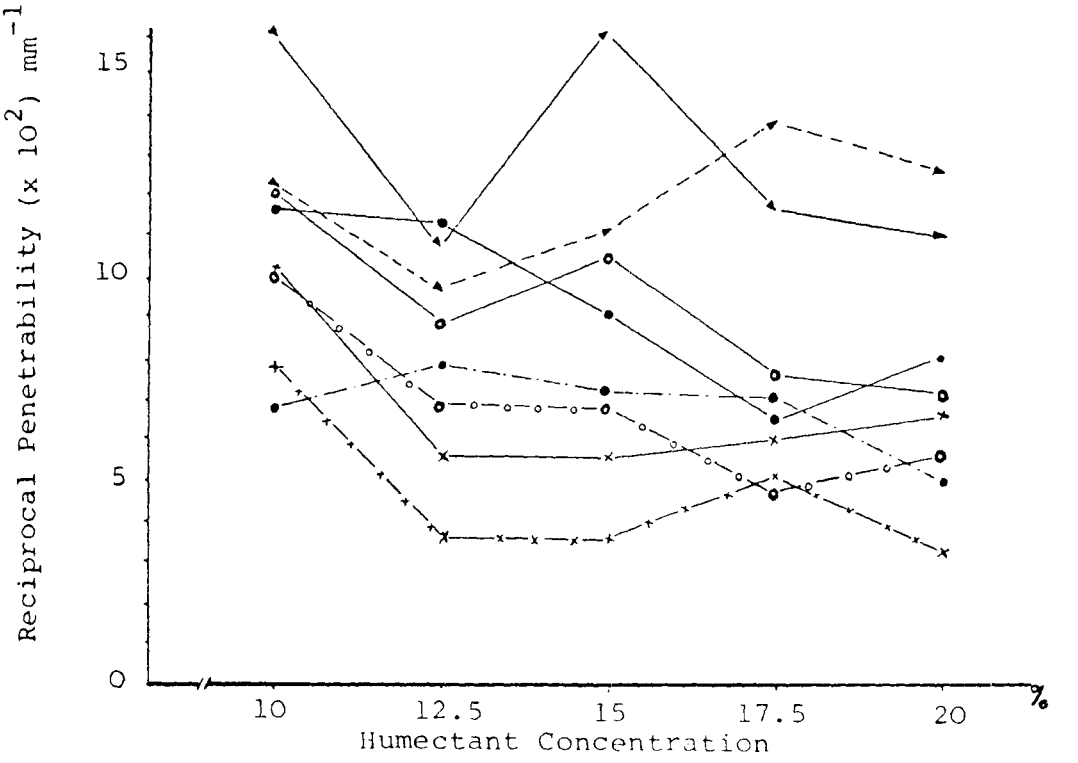

FIGURE 8
Influence of Chlorphenesin (1%) on the Penetrability of the Selected Stick Bases. Key: as fig. 1.

Yield by abrasion:

-Panthenol: Fig. 13 shows that Panthenol obviously increases the yield by abrasion of the investigated SSSS bases to different extents.

Indeed, Panthenol was reported to be an excellent humectant and spreading promoting factor (9,24), imparting better glide and clarity to Cologne sticks (7).

-Chlorphenesin: Fig. 14 shows that, as in the case of Panthenol, Chlorphenesin increases the yield by abrasion values of the corresponding bases; however, in the case of glycerol-formulated

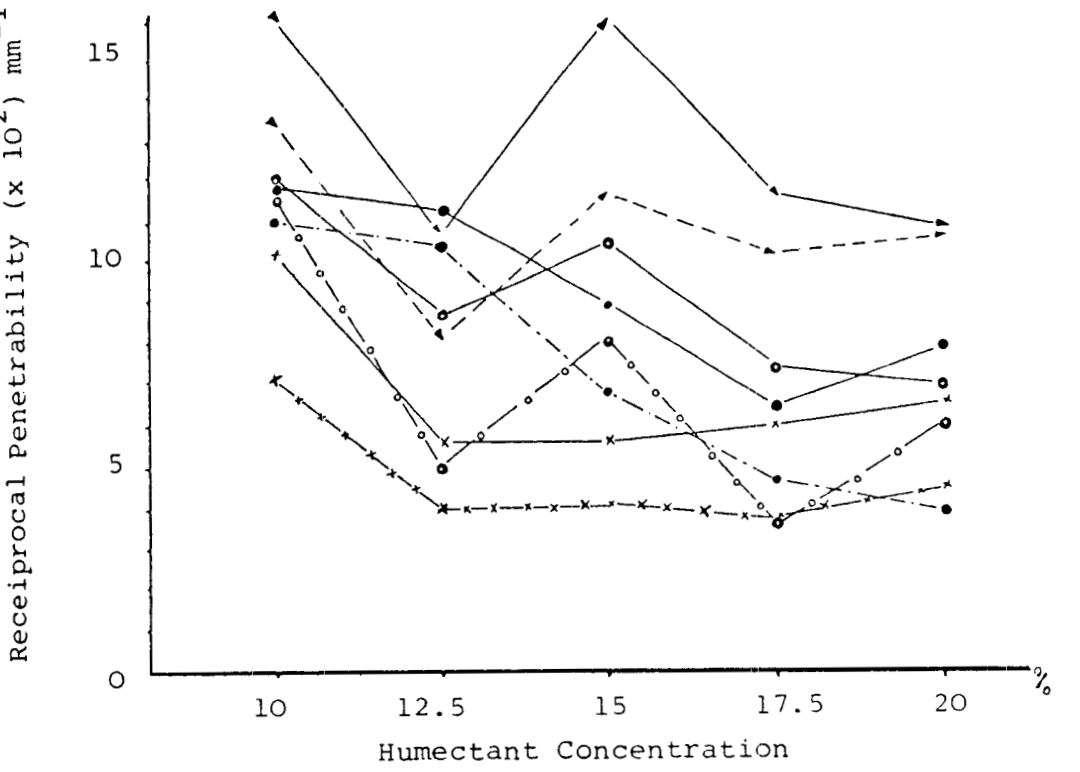

FIGURE 9
Influence of Lignocaine (2%) on the Penetrability of the Selected Stick Bases. Key: as fig. 1.

sticks, this is true only above 15% humectant concentration. Again, PEG 400-formulated Chlorphenesin sticks show the highest yield by abrasion values.

-Lignocaine: Fig. 15 shows that glycerol or PEG 600-formulated Lignocaine sticks show slightly higher yield by abrasion values than their corresponding bases, below 15% humectant concentration; above this humectant concentration Lignocaine sticks show slightly higher yield by abrasion values than their corresponding bases. Again, PEG 400-formulated Lignocaine sticks show the highest yield by abrasion values. In the case of sticks containing

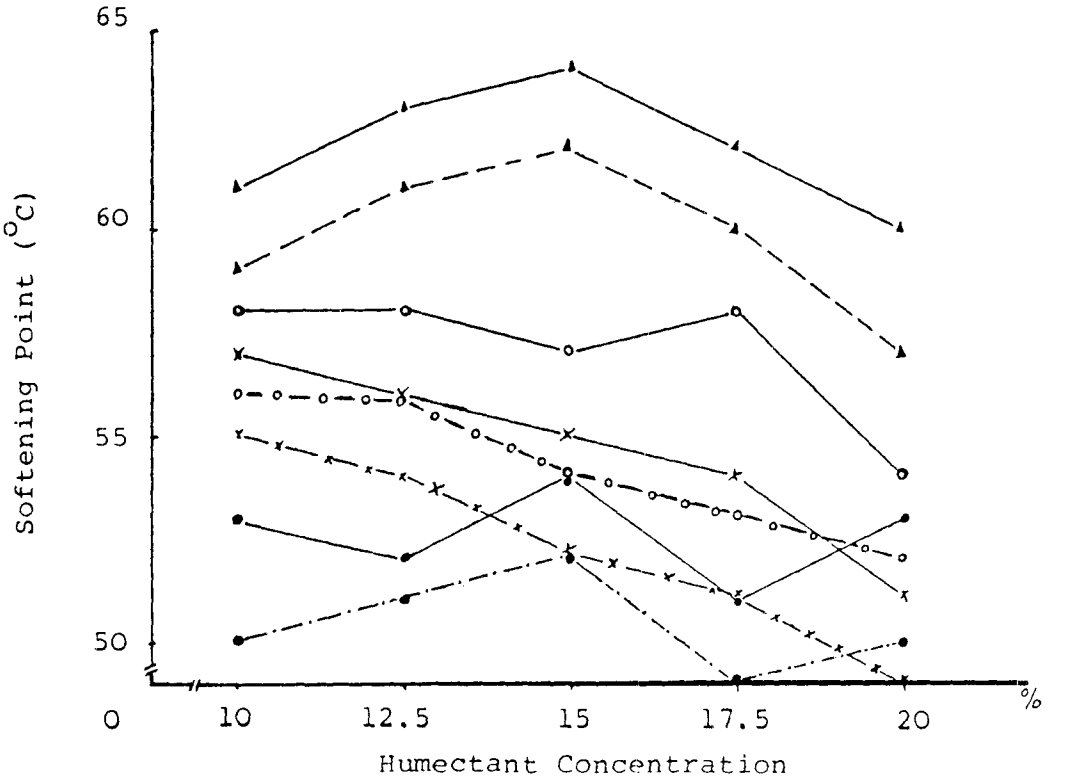

FIGURE 10
Influence of Panthenol (5%) on the Softening Point of the Selected Stick Bases. Key: as fig. 1.

PG as humectant, the curves for the medicated and non-medicated sticks intercept at many points denoting that Lignocaine does not affect the yield by abrasion values of the corresponding bases to a great extent.

It is noteworthy to recall that the yield by abrasion value reflects the limits above or below which a specific formula becomes unapplicable. This is true as far as the quantity of the stick released on the skin by gentle rubbing is taken

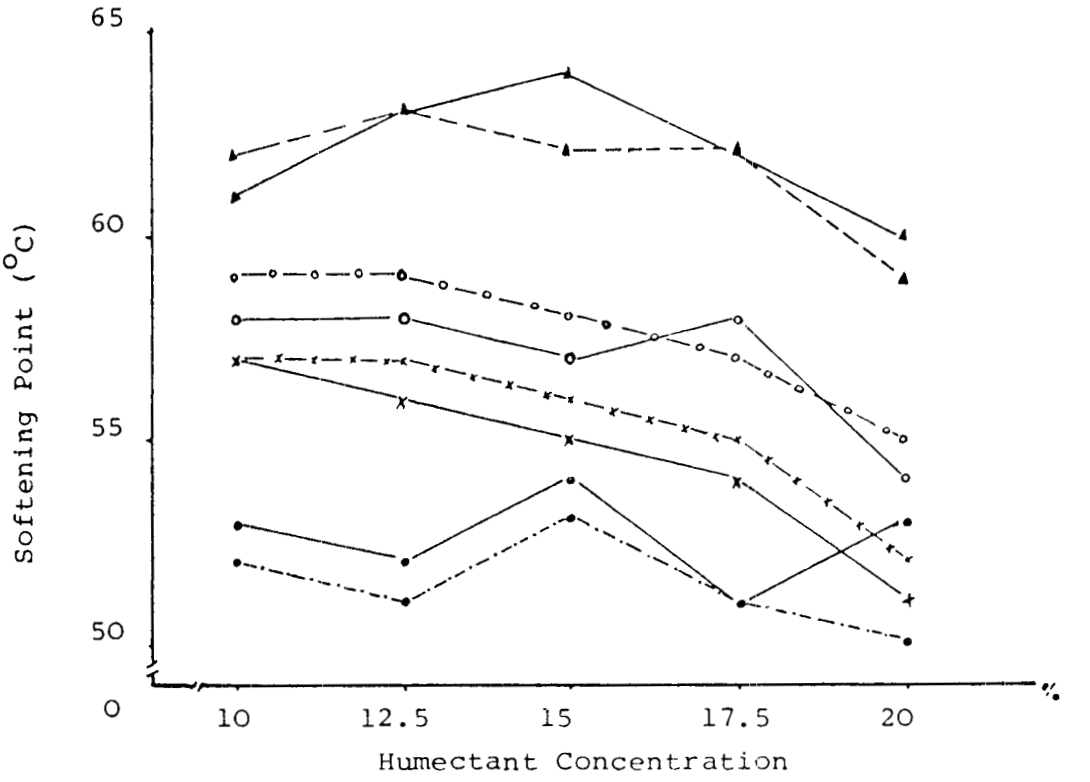

FIGURE 11
Influence of Chlorphenesin (1%) on the Softening Point of the Selected Stick Bases. Key: as fig. 1.

as an index to dosage definition (25-27). As a practical finding, this parameter was noticed to be influenced by the toughness, friability or plasticization of the stick mass (28,29); a well plasticized stick would yield comparatively lower quantities due to the relatively strong bonding within the gel structure.

Rate of Drying of the Sticks by Evaporation:

-Panthenol: Fig. 16 shows that there is an appreciable lowering in the maximum percent weight loss by evaporation from the

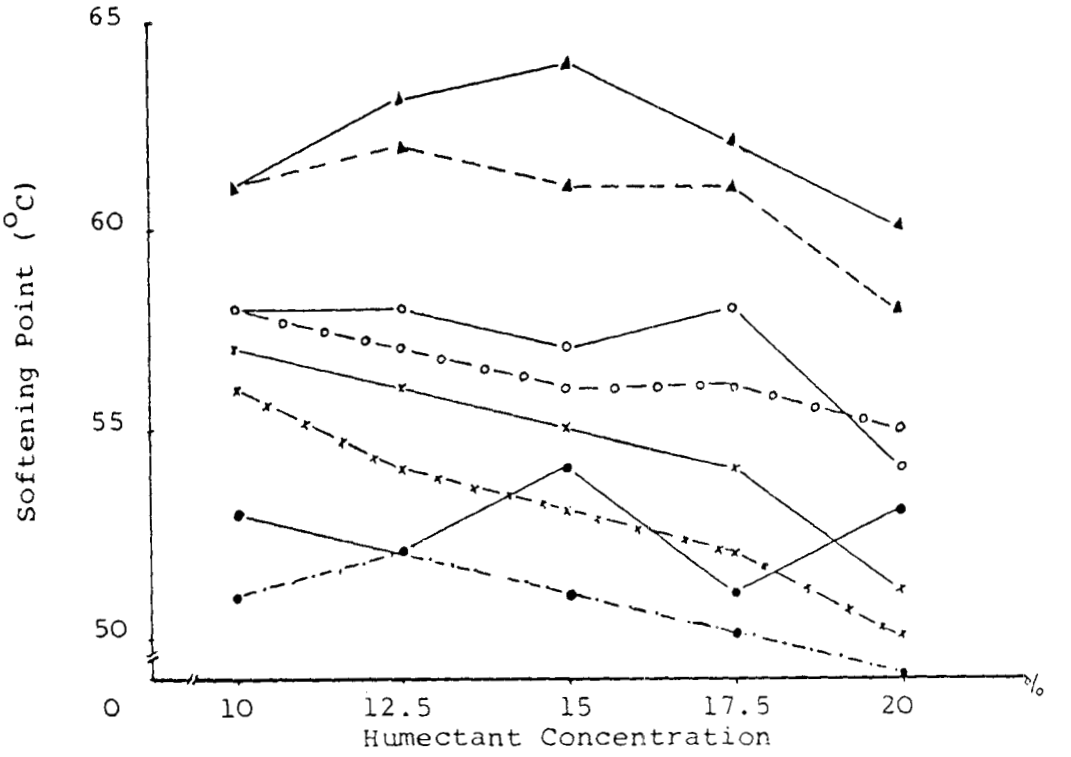

FIGURE 12
Influence of Lignocaine (2%) on the Softening Point of the Selected Stick Bases. Key: as fig. 1.

bases as a result of the addition of Panthenol to the respective formulations. Moreover, Table 2 shows that Panthenol sticks show the least weight loss by evaporation among all investigated medicated sticks. The increased weight loss from Panthenol sticks containing more than 17.5% glycerol or polyethylene glycols, is mainly due to syneresis (23,30).

-Chlorphenesin: Table 2 shows that Chlorphenesin sticks do not differ much from their corresponding bases in their rate of

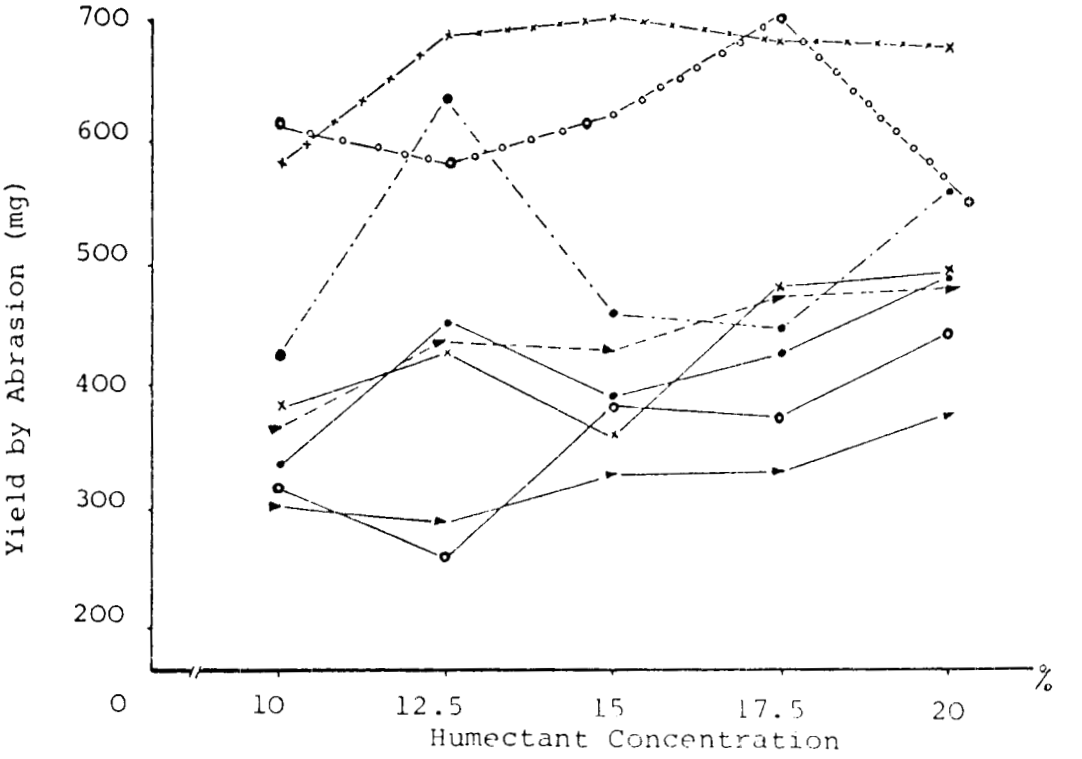

FIGURE 13
Influence of Panthenol (5%) on the Yield by Abrasion Given by the Selected Stick Bases. Key: as fig. 1.

drying by evaporation, denoting the negligible influence of the drug on this parameter.

-Lignocaine: Table 2 shows that there is no significant difference between sticks containing Lignocaine and their corresponding bases as far as the rate of drying evaporation parameter is concerned. An exception may be offered by medicated sticks with a high humectant content which may show somewhat lower values than their corresponding bases.

The unique behaviour of Panthenol sticks may be attributed to the solubility of this drug in both water and alcohol (7,9)

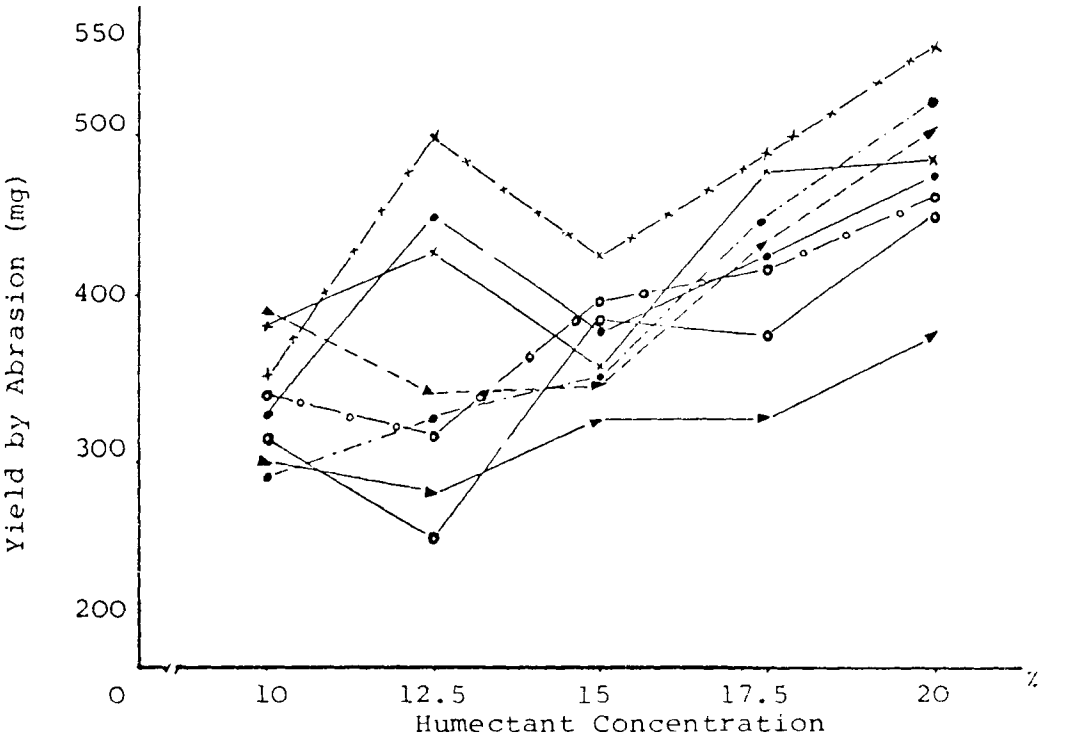

FIGURE 14
Influence of Chlorphenesin (1%) on the Yield by Abrasion Given by the Selected Stick Bases. Key: as fig. 1.

both present in SSSS (23). This enables Panthenol to keep the solvents entrapped in the gel structure for longer periods. Accordingly, one might suggest the inclusion of Panthenol as a basic ingredient in SSSS bases, whenever possible.

CONCLUSIONS

1. The disintegration time of the studied SSSS bases is generally lowered by the three investigated medicaments; however, glycerol or PG-formulated stick bases find their disintegration time

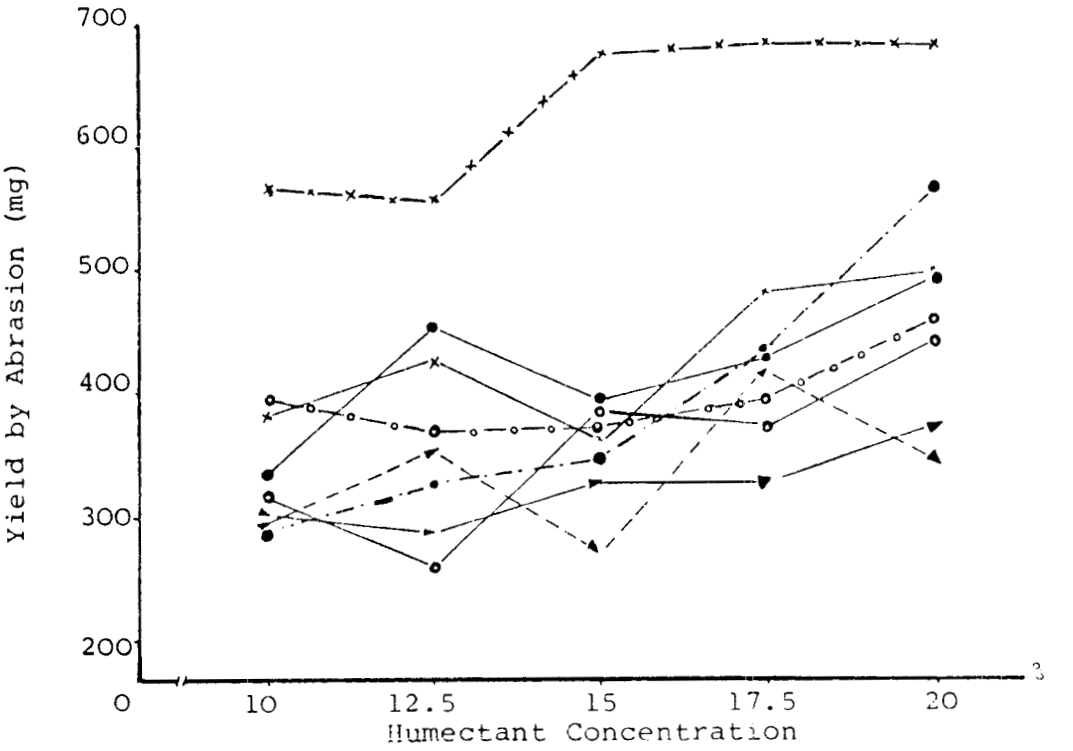

FIGURE 15
Influence of Lignocaine (2%) on the Yield by Abrasion Given by the Selected Stick Bases. Key: as fig. 1.

slightly prolonged or unaffected by the addition of Chlorphenesin or Lignocaine.

2. Panthenol generally lowers the hardness of the investigated bases, PG bases being least affected. Hardness is generally increased with Chlorphenesin or Lignocaine, but to a lesser extent with the latter drug.

3. Generally speaking, Panthenol markedly increases the penetrability of the investigated stick bases; Chlorphenesin and Lignocaine also do so but to a lesser extent.

4. The softening point of the SSSS bases is generally lowered in presence of Panthenol or Lignocaine; Chlorphenesin does not

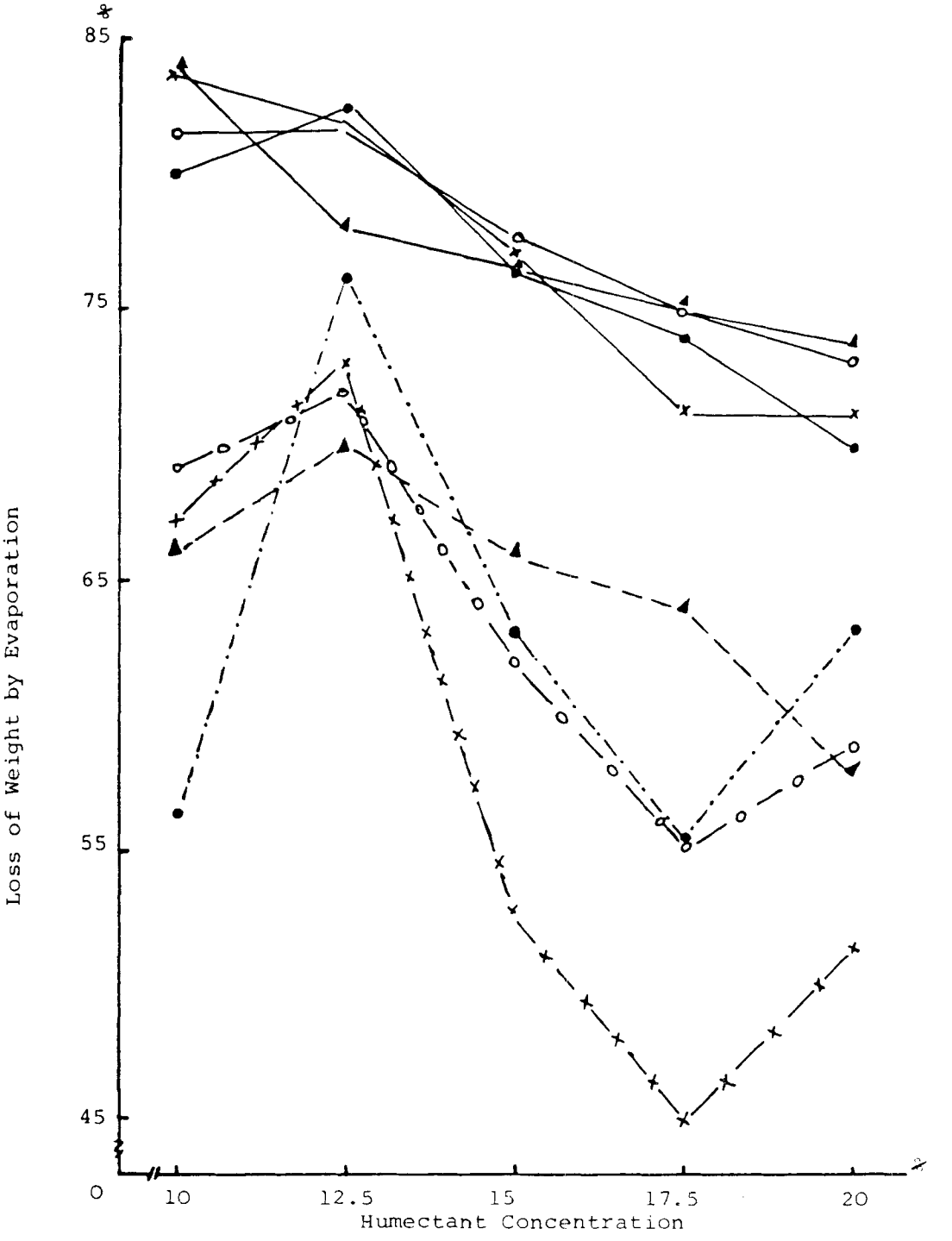

FIGURE 16
Comparison of the Maximum Percent Weight Loss by Evaporation of Panthenol Sticks and their Respective Bases. Key: as fig. 1.

generally affect the softening point of the stick bases; anyhow, the softening point of the investigated medicated sticks points out to their resistance to handling and storage in areas with occasional hot summers.

5. Panthenol appreciably increases the yield by abrasion of all investigated bases; Chlorphenesin and Lignocaine do not appreciably influence this parameter except in the case of PEG 400 bases where the yield is markedly increased in presence of Lignocaine.

6. The rate of drying by evaporation of all investigated stick bases is greatly lowered on addition of Panthenol; Chlorphenesin and Lignocaine affect this parameter to a much lesser extent. The inclusion of Panthenol, whenever possible, as a basic ingredient in SSSS bases is suggested.

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