RESEARCH PAPER

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In vitro Adsorption of Pseudoephedrine Hydrochloride onto some Adsorbents and Antacids

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The adsorption of pseudoephedrine hydrocholoride on charcoal, magnesium trisilicate, bismuth carbonate, light magnesium oxide, kaolin and talc was investigated. Maximum adsorption was found with charcoal followed by magensium trisilicate. Behaviour of charcoal and magnesium trisilicate followed Langmuir and Freundlich Isotherms. The present study also reveals that coadministration of pseudoephedrine hydrochloride with the above mentioned adsorbents and antacids is contraindicated.

THERE are several reports of drug-drug interactions involving adsorbents used as antacids and antidiarrhoels[1-3]. Such interactions may decrease the bioavailability of drugs.[4-8] The present work describes the possible effect of various absorbents and antacids on the bioavailability of pseudoephedrine hydrochloride which may be consumed concomitantly.

MATERIALS AND METHODS

Materials

Charcoal, magnesium trisilicate (MTS), bismuth carbonate (BC), light magensium carbonate (MC), light magnesium oxide (MO), kaolin and talc. Pseudoephedrine hydrochloride was compendial grade and was used without further purification. All the chemicals used were of analytical reagent grade and obtained from various sources - charcoal from E. Merck India Ltd., Bombay; magnesium trisilicate, talc and pseudoephedrine hydrochloride from Ajay Enterprises, Madras ; bismuth carbonate and light magnesium oxide from Loba. Chem., Bombay; kaolin and light magnesium carbonate from S.D. Fine Chem. Pvt. Ltd., Boisar.

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Adsorption Study

Volumes of 20 ml containing increasing initial concentration of pseudoephedrine hydrochloride in distilled water (100 - 50 mg/100 ml) were prepared in tightly closed conical flasks. In each experiment, 0.5 g of each adsorbent under investigation was added to pseudoephedrine hydrochloride solutions of various concentrations. The flasks were shaken horizontally in a thermostatically controlled water bath (YSI-415 YORCO) at 37° for 2 h. A previous study had shown that the time of maximum adsorption was 1 h. Subsequently, flasks were set aside for further 4 h, to attain equilibrium and then filtered. Aliqutos from the filtrate were taken for determination of the amount of free drug spectrophotometrically[9] at 515 μm.

The experiments were performed in duplicate and the results obtained were appropriately treated to construct the adsorption isotherms, Langmuir and Freundlich plots.

Effect of weight of adsorbents

Charcoal, MTS, BC, MC, MO, kaolin and talc were used in these experiments. The conditions of these experiments were the same as described

Table - 1: Langmuir and Freundlich parameters for adsorption of pseudoephedrine hydrochloride on Charcoal, MTS, BC and MO

Adsorbent	Langmuir constants		Freundlich constants	
	K_2	K_1	K	P
Charcoal	135.13	0.164	6.300	0.577
MTS	111.53	0.006	0.870	0.830
BC	21.77	0.015	0.363	0.320
MO	38.09	0.010	0.724	0.720

Table - 2: Amount of pseudoephedrine hydrochloride adsorbed (x/m, in mg / g)

Adsorbent	Initial conc. of pseudoephedrine HCl (mg / 100 ml)				
	100	200	300	400	500
Charcoal	37	60	52	88	100
M.T.S.	13	24	24	34	52
B.C.	5	8	8	10	22
M.C.	2	11	18	24	42
M.O.	6	13	14	16	20
Kaolin	15	16	16	40	48
Talc	4	8	24	28	54

above except that a constant initial concentration (250 mg / 100 ml) of pseudoephedrine hydrochloride was added to the variable weights of each adsorbents (100 - 900 mg).

RESULTS AND DISCUSSION

Adsorption isotherms

Amounts of pseudoephedrine hydrochloride in mg per g adsorbent (x/m) were calculated for each adsorbent and plotted against the respective equilibrium concentration (C). Different types of adsorption isotherms were obtained. Adsorption of pseudoephedrine hydrochloride onto charcoal and MTS are type I (**Fig. 1 and 2**) isotherms where as, MC, BC and talc are type III (**Fig. 1 and 2**). Adsorption isotherms of MO and kaolin are type II and type V respectively (**Fig. 3**), (Martin *et al.*[10])

The values of x/m and C were subsequently treated to construct the Langmuir and Freundlich plots according to eq. 1 and 2 respectively:

$$ {}^{C}/x/m = {}^{1}/k1k2 + {}^{C}/K2 \quad \ldots\ldots\ldots\ldots \quad 1 $$

$$ \log(x/m) = \log K - P \log C \quad \ldots\ldots\ldots\ldots \quad 2 $$

Where k_1, k_2, K and P are constants. Only the results of charcoal, magnesium trisilicate and magnesium oxide fitted both equations. Values of Lagmuir constants, k_1 and k_2, and Freundlich constants, K and P are summarized in **Table 1**. Higher values of k_1 and k_2 show that the adsorption capacity of charcoal as well as the force of interaction with

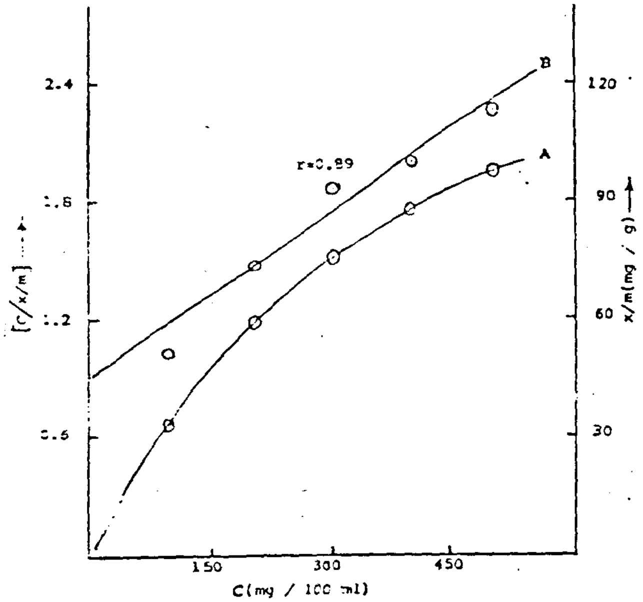

Fig.1: Adsorption of pseudoephedrine hydrochloride on charcoal. A: adsorption isotherm. B: Langmuir plot. y=0.4566+0.0072x

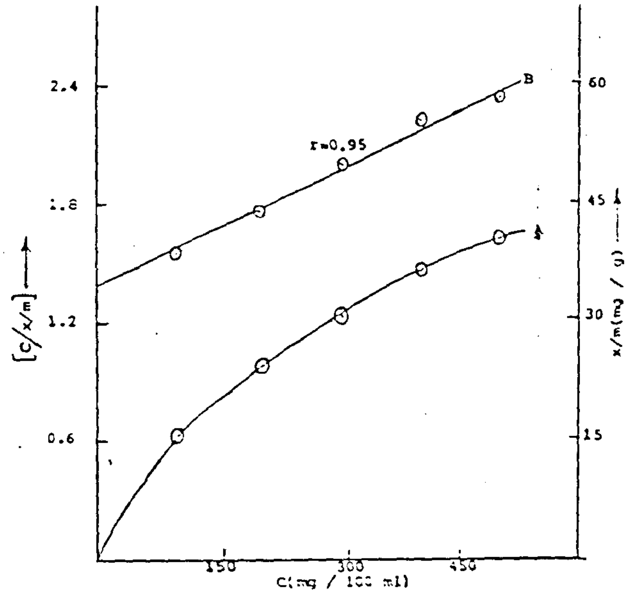

Fig. 2: Adsorption of pseudoephedrine hydrochloride on magnesium trisilicate. A: adsorption isotherm. B: Langmuir plot. y=1.4656 + 0.00879x

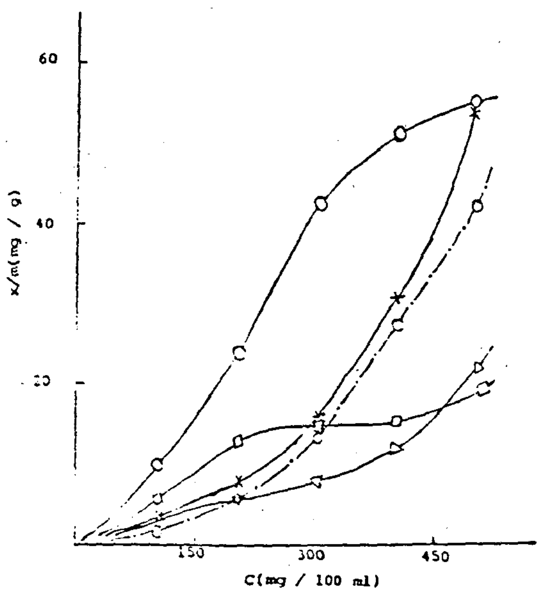

Fig.3: Adsorption isotherms for pseudoephedrine hydrochloride onto different adsorbents, (o) kaolin; (x), talc; (D) bismuth corbonate; (□), magnesium oxide; (-.-.-) magnesium carbonate.

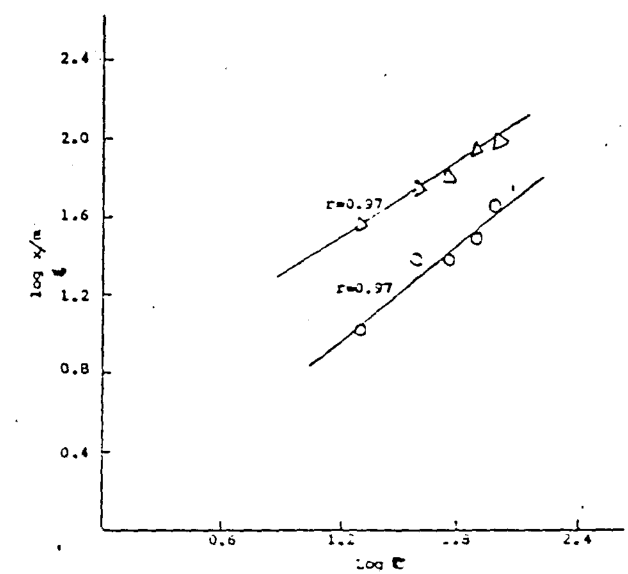

Fig. 4: Freundlich isotherms for the adsorption of pseudoephedrine hydrochloride on (Δ), charcoal, y=0.7433+0.6164x; (o), MTS, y=-0.017+0.838x.

pseudoephedrine hydrochloride are more profound and strong, in comparison with other adsorbents under the same experiments conditions. It is obvious from values of k (Table 1), that the amount of pseudoephedrine hydrochloride adsorbed on charcoal was larger than the corresponding values of other adsorbents. Lower values of P (Table 1) show that with decreasing concentration of pseudoephedrine

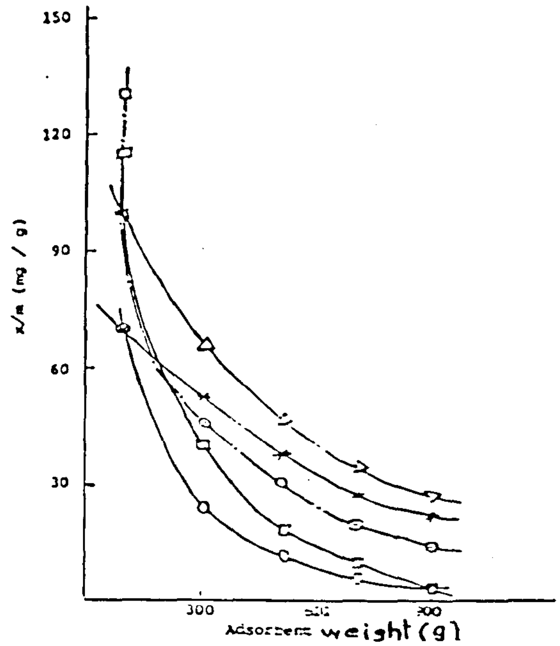

Fig.5: The relationship between adsorbent weight and adsorption of pseudoephedrine hydrochloride, (o), kaolin; (□), magnesium carbonate; (-.-.-), talc; (x) MTS; (Δ), Charcoal.

hydrochloride, its adsorption became more efficient on charcoal (**Fig. 4**) . Furthermore, to allow better comparison between all tested adsorbents and antacids, the values of (x/m) for each adsorbent at the following initial concentrations, 100, 200, 300, 400 and 500 mg / 100 ml for each adsorbent were calculated and are presented in table 2. The decrease in (x/m) values could be arranged in the following sequence, Charcoal, M.T.S., Kaolin, Talc, M.C., M.O. and B.C.

It is obvious from the results, obtained in this study that the mixing of pseudoephedrine hydrochloride with one or more of the studied absorbents during preparation of pharmaceuticals or during coadministration of these materials with pseudoephedrine hydrochloride, could decrease its bioavailability.

Effect of absorbent weight

In this study an initial concentration of Pseudoephedrine hydrochloride (250 mg / 100 ml) was used. **Fig. 5** shows the relationship between variation in (x/m) values with amounts of each adsorbent. The values of (x/m) decreased sharply by increasing the weight of adsorbent in the lower range (0.1 - 0.5 g). This step was followed by a moderate drop in (x/m) values at the higher weight range (0.5 - 0.7 g). Above results show that even a small amount of adsorbent effected the adsorption of pseudoephedrine hydrochloride.

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