Limitations of liquid penetration in predicting the release of drugs from hard gelatin capsules

In an attempt to explain factors affecting the release of drugs from capsules, Samyn & Jung (1970) used the liquid penetration test of Studebaker & Snow (1955). The former authors concluded that extended dissolution rates are obtained with powder blends that show reduced liquid penetration. We have found that this is not always to be the case. This can be illustrated by the results in Fig. 1a and b where the dissolution of capsules containing a water-insoluble drug plus various additives is compared with the liquid penetration of the same powder blends. Thus, poor liquid penetration does not necessarily ensure poor dissolution of the drug from the capsule. The blend which

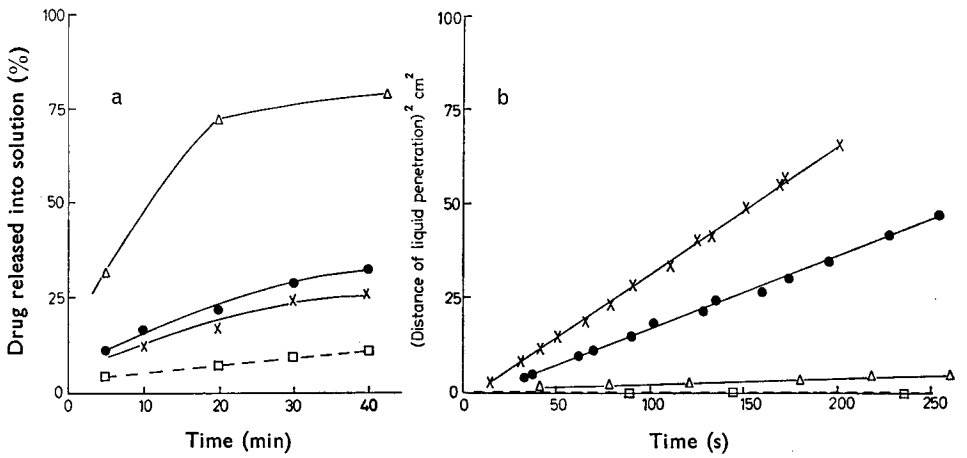

FIG. 1. (a). The percentage of drug released from the capsule into solution at known time intervals. (Dissolution test carried out as described by Newton and Rowley, 1970). (b). The square of the distance of liquid penetration against the time of flow. □ - - - - - □ Drug + magnesium stearate 0·5 w/w. X——X Drug + magnesium stearate 0·5% w/w, sodium lauryl sulphate 1% w/w, lactose 5% w/w. ●——● Drug + magnesium stearate 0·5 w/w, sodium lauryl sulphate 1% w/w, lactose 20% w/w. △——△ Drug + magnesium stearate 1·0% w/w, sodium lauryl sulphate 1% w/w, lactose 50% w/w.

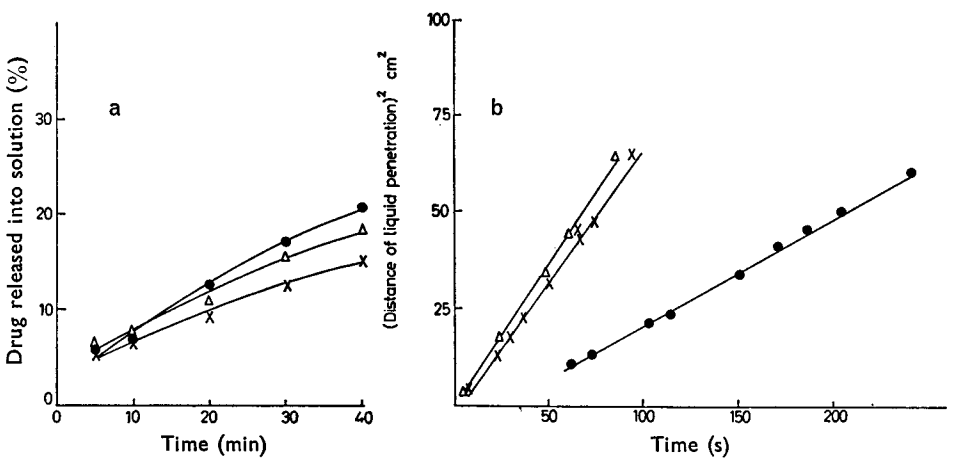

FIG. 2. (a). The percentage of drug released from the capsule into solution, at known time intervals (Dissolution test carried out as described by Newton & Rowley, 1970). (b). The square of the distance of liquid penetration against time of flow. ●——● Drug. X——X Drug + sodium lauryl sulphate 0·5% w/w. △——△ Drug + sodium lauryl sulphate 1·0% w/w.

allows no liquid penetration does, however, have the lowest dissolution. The results also show that rapid liquid penetration does not ensure good dissolution characteristics, further illustrated in Fig. 2a and b, where the presence of wetting agent readily promotes liquid penetration but does not assist dissolution. The liquid penetration test can help in the screening of wetting agents, but we consider that its extension to the prediction of drug release from capsules may not be possible.

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The effect of ethanol and amphetamine mixtures on the activity of rats in a Y-maze

Low doses of sodium amylobarbitone potentiated the stimulant effect of (+)-amphetamine sulphate on the behaviour of rats in the Y-maze (Steinberg, Rushton & Tinson, 1961; Steinberg, 1963; Rushton & Steinberg, 1963). Since the pharmacological properties of ethanol are similar to those of the barbiturates, it was of interest to see whether it shared with barbiturates the ability to potentiate the effect of amphetamine on the performance of rats in a Y-maze.

The experiment was made in a darkened room, the maze being illuminated by diffuse light from a lamp held in close proximity. The Y-maze, painted a uniform grey, was of the dimensions described by Rushton & Steinberg (1963). Male rats of the Wistar strain, initially weighing 150g, were maintained on a reversed 12 h lighting schedule. Food and water were freely available apart from the 3 min period when the rats were in the maze. The rats were kept singly in polythene cages throughout the experiment. In a preliminary experiment the time when the animals showed peak activity in the Y-maze was found to be 13·30 h and therefore all subsequent trials were conducted at this time. Only those rats with an activity score greater than 5 per 3 min trial were used. Each rat was run in the maze once a week for 5 weeks. This frequency was found in a preliminary experiment to be insufficient for the animals to become habituated to the maze. The rats were divided into 4 groups, each containing 5 animals. The effects of alcohol and amphetamine, alone and in combination, were tested over a period of five weeks. For one week in the five, the rats received no drugs, and hence acted as their own controls. During the other 4 weeks, ethanol and amphetamine were given in doses of 50–800 mg/kg and 4 mg/kg respectively, or in combinations of varying amounts of alcohol with 4 mg/kg of amphetamine.

All rats were pretreated with ethanol, (+)-amphetamine sulphate or the mixture for 15 min before being run in the maze. The drugs were given intraperitoneally in a volume of less than 0·5 ml/rat; the control group was injected with 0·5 ml of physiological saline.

Ethanol alone caused a slight increase in the Y-maze activity compared to the controls, in the lower dose used, but higher doses caused a decrease in exploratory activity (Fig. 1). Amphetamine, even in the lower dose used, increased the Y-maze activity. When these drugs were administered in combination, it was apparent that the depressant effect of ethanol was antagonized by amphetamine but at no dose