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COMMUNICATION

# EVALUATION OF MICROCRYSTALLINE CELLULOSE PREPARED FROM ABSORBENT COTTON AS A DIRECT COMPRESSION CARRIER

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## ABSTRACT

A study has been carried out to examine the feasibility of the use of microcrystalline cellulose (MCC-A) prepared from the absorbent cotton as a direct compression carrier. Tablets made with MCC-A were of equally good quality. The release of test drug diazepam from the tablets was faster than from the tablets made with two MCC commercial grades (MCC-B and MCC-C). The compressional forces - disintegration profile was also comparable.

## INTRODUCTION

Interest in the direct compression of pharmaceutical compounds into tablets has increased during recent decades (1-4). Various methods (5,6) have been reported to prepare MCC from the absorbent cotton but the experimental data for its use as a direct compression carrier or as a disintegrant is scanty. In the present study, therefore, an attempt has been made to evaluate the MCC prepared from the absorbent cotton and examination of its feasibility as a direct compression carrier or disintegrant.

## MATERIALS AND METHODS

### Preparation of Microcrystalline Cellulose (MCC-A)

MCC-A was prepared from the absorbent cotton by digesting with 5 N HCl at 105±1°C for 4.5 hr (5,6). The slightly wet mass

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was passed through a stainless sieve of a particular size to get spherical particles and dried. It was evaluated for compendial specifications.

Particle Size,Bulk Density and Moisture Content Determinations

Particle size by the microscopic method, bulk density (7) and moisture content (8) at 140° of MCC-A and the commercial grades (MCC-B[1] and MCC-C[2]) were determined. From the bulk density, the bulk (ml/g) was calculated.

Flow Characteristics

Angle of repose (9), percent compressibility and cohesion(10), and flow rate (11) were determined. The results obtained were utilized to assess the flowability which was based on points allocated to the former three characteristics (10) and the data were compared on the basis of the flowability points.

Evaluation of Compressional Characteristics

Firstly, tablets of five formulations, using diazepam(5mg) as a test drug, starch(7.5mg), magnesium stearate(1.125mg), talc (0.75mg), MCC-A, MCC-B or MCC-C (22.5,22.5,18.75,15 and 11.25 mg for formulation I,II,III,IV & V, respectively) and lactose to adjust tablet weight to 100 mg, were compacted at a compressional force of $3.5 \times 10^3$ kg/cm² on an instrumental rotary tablet press[3] using 7 mm circular standard concave punch. Formulation I was made without using starch and lubricants. Secondly, a complete pressure-hardness and pressure-disintegration time profiles were generated at a series of pressures (1,2,3,5 and $10 \times 10^3$ kg/cm²). For this purpose, the study was restricted to formulation III.

Characteristics of the Tablets

The tablets were studied according to compendial specifications. Diazepam was assayed(12) spectrophotometrically at 284nm. Dissolution profiles were determined for each product on six indi-

[1]Supplied by Roussel Pharmaceuticals, Bombay (India).
[2]Cellulose products of India, Ahmedabad.
[3]Cadmach Rotary Tablet Press Model 16 stations equipped with strain gauges.

vidual tablets at 37±0.5°C using a USP XVIII dissolution apparatus (rotating basket method) (13) and at a stirrer speed of 30 rpm. 0.1 N HCl (400 ml) was used as the dissolution medium. At various time intervals, aliquots (5 ml) were withdrawn and replaced by the fresh medium and analysed using spectrophotometer (Perkin Elmer, Model Hitachi 200) at 284 nm.

## RESULTS AND DISCUSSION

MCC-A prepared by us conformed to compendial specifications. The average particle size and the bulk density of MCC-A (Table 1 ) was comparable to but denser than the others. The moisture content of MCC-A was found to be 1.16% w/w (expressed as loss on drying) while that of MCC-B and MCC-C was 4.12 and 0.77% w/w, respectively. The better flow characteristic of MCC-A in comparison to other grades could be attributed to the relatively granular shape. The score points allocated according to Carr's method were 61.5 out of 75. The points for a material to be free flowing have been reported (10) to be 70 or more out of 100. Although the weight variation of all the formulations were well within the compendial limits (7.5%), but the tablets, except formulations IV and V that failed in friability, made with MCC-A was better, probably due to the better flowability, than those made with others. Relatively large differences in drug release (Fig.1) were observed among tablets prepared with MCC-A, MCC-B or MCC-C and the variation in drug release from the tablets with MCC-A ($t_{90\%}$=5.2 to 12.9min) may be attributed to better characteristics of MCC-A than those of others.

### Effect of Compression Forces on Tablet Characteristics

Although hardness is not a fundamental property, its use in in-process quality control during tablet production warrants consideration. The hardness initially increased with compressional force but further increase in force had no effect on the hardness, rather decreased the hardness (Fig.2,a).

The effect of compressional force on the tablet disintegration time in Fig.2(b) shows two types of disintegrant behaviour.

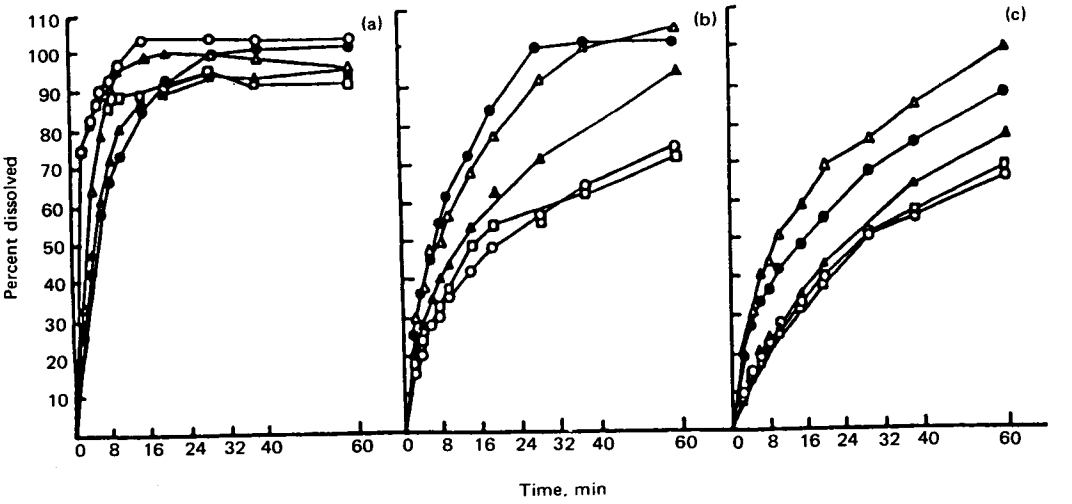


FIGURE 1

Dissolution rate profiles of different formulations of diazepam tablets made with (a)MCC-A,(b) MCC-B and (c) MCC-C. Formulation I ( □ ), II( ○ ),III ( ▲ ), IV ( ● ) and V ( Δ ).

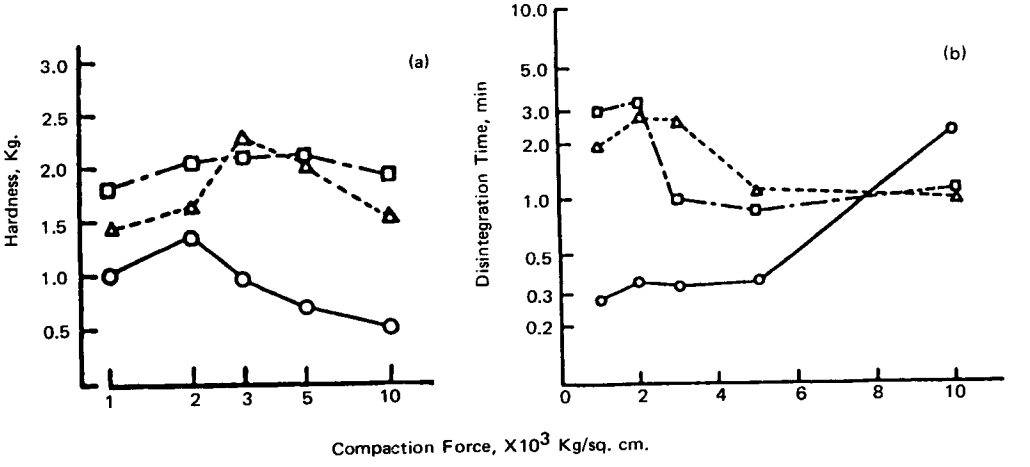


FIGURE 2

Effect of compaction force on (a) hardness (b) disintegration time of diazepam tablets made with MCC-A ( ○—○ ), MCC-B ( □··□ ) and MCC-C ( Δ--Δ ).

TABLE 1

Physical Parameters of MCC-A and other Commercial Grades

| Parameter | MCC-A | MCC-B | MCC-C |
|---|---|---|---|
| Average particle size, $d_{sn}(\mu)$ | 52.55 | 50.38 | 55.50 |
| Density, (g/cm³) | 1.43 | 1.41 | 1.48 |
| Bulk density, (g/ml) | 0.56 | 0.17 | 0.14 |
| Bulk, (ml/g) | 1.79 | 5.88 | 7.14 |
| Loss on drying, (%) | 1.16 | 4.12 | 0.77 |
| Angle of repose (θ°) | 28.69 | 62.01 | 57.02 |
| Compressibility, (%) | 9.14 | 51.43 | 49.03 |
| Cohesion,(%) | 0.50 | 0.40 | 0.53 |
| Flow rate, (g/sec) | 4.50 | plug flow | plug flow |
| Flowability, according to Carr's method, (total score points=75) | 61.5 | 22.0 | 22.0 |

In the first type (with MCC-A), the disintegraion time initially increased after which a further increase in force appeared to have no effect on it, but behaviour at 5 x 10³ kg/cm² compressional force appeared to be fascinating, the disintegration time increased dramatically. In the other case,the disintegration after an initial increase showed a dramatic decrease, after which no significant effect was observed on the disintegration time. Usually, as the compressional force used to prepare a tablet is increased, the disintegration time is increased but formulations made with MCC-B and MCC-C showed the reverse.Although the disintegration was extremely rapid for all the formulations, the pattern varies with the tablets made with these. This behaviour might be explained on the basis of hypothesis proposed (14-16).

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