lations.[14,15] These results indicate that further addition of HPMC as a binder can improve cohesion during granulation operations and enlarge granule particle sizes by using a lower percentage of film-forming polymers. Hence, matrix granule formulations were designed as delineated in Tables 1 and 2 for lactose and dicalcium phosphate, respectively. The physical properties of lactose and dicalcium phosphate matrix granules used for preparing nifedipine matrix tablets are also listed in Tables 1 and 2, respectively.

As shown, the fraction of fine particles of both lactose and dicalcium phosphate matrix granules decreased with increasing percentages of EC. The fraction of fine particles for the latter was even smaller than that of the former. The angle of repose is affected by the particle size distribution, and it generally increases with decreased particle size. Values of the angle of repose obtained for granulated excipients were

Table 1. Formulations and Physical Properties of Lactose Matrix Granules

Lactose formulation	L1	L2	L3	L4	L5
Percent of EC [a]	1	1	3	3	5
Percent of HPMC [b]	--	2	--	2	2
Particle size distribution (mesh no.)[c]					
24 (0.710 mm)	0.2	0.1	0.1	0.2	0.2
32 (0.500 mm)	7.7	8.4	17.3	14.2	18.1
42 (0.355 mm)	20.4	20.3	36.7	32.6	34.5
60 (0.250 mm)	32.5	31.3	51.1	47.3	52.8
80 (0.180 mm)	44.1	42.7	62.4	59.8	64.9
115 (0.125 mm)	58.0	57.9	72.6	72.4	78.1
Angle of repose (°)	34.2 (1.2)[a]	31.0 (1.6)	36.3 (1.4)	39.7 (0.8)	39.1 (1.0)
Bulk density (mg/ml)	0.52 (0.02)	0.52 (0.01)	0.51 (0.01)	0.48 (0.01)	0.50 (0.01)
Tapped density (mg/ml)	0.58 (0.01)	0.61 (0.01)	0.56 (0.02)	0.55 (0.01)	0.57 (0.01)
Carr's index (%)	9.8	14.5	8.7	12.5	10.1

[a]Percent w/w of ethylcellulose in lactose; [b]percent w/w of HPMC in lactose; [c]cumulative percentage retained; [d]mean (S.D) (standard deviation, $n = 3$).

Table 2. Formulations and Physical Properties of Dicalcium Phosphate Matrix Granules

Dicalcium phosphate formulation	D1	D2	D3	D4	D5
Percent of EC [a]	1	1	3	3	5
Percent of HPMC [b]	2	4	2	4	
Particle size distribution (mesh no.)[c]					
24 (0.710 mm)	0.6	2.7	2.9	2.6	1.0
32 (0.500 mm)	18.0	47.4	34.2	31.7	29.4
42 (0.355 mm)	40.2	77.4	64.3	67.7	56.5
60 (0.250 mm)	62.8	92.0	82.8	87.7	74.5
80 (0.180 mm)	82.8	97.9	91.3	95.3	84.2
115 (0.125 mm)	92.1	98.3	94.7	97.8	89.3
Angle of repose (°)	26.7 (1.7)[d]	29.2 (1.2)	30.7 (1.5)	30.3 (0.3)	31.2 (2.0)
Bulk density (mg/ml)	0.78 (0.01)	0.69 (0.01)	0.69 (0.01)	0.71 (0.01)	0.66 (0.01)
Tapped density (mg/ml)	0.81 (0.01)	0.71 (0.01)	0.71 (0.02)	0.73 (0.01)	0.69 (0.01)
Carr's index (%)	3.8	3.5	3.0	2.6	3.7

[a]Percent w/w of ethylcellulose in dicalcium phosphate; [b]percent w/w of HPMC in dicalcium phosphate; [c]cumulative percentage retained; [d]mean (S.D) (standard deviation, $n = 3$).