Development of Caffeine Extended Release Tablets Using Carbomer Homopolymer

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OBJECTIVE

To develop and evaluate cost effective caffeine extended release tablets with a 6–12 hour release target, by using Carbomer Homopolymer Type A (Carbopol® 971P NF polymer) as a matrix forming excipient.

METHODOLOGY

Materials

Caffeine anhydrous granular 0.07/0.5 (BASF Corp., Florham Park, NJ), Carbopol® 971P NF polymer (Lubrizol Advanced Materials, Inc., Cleveland, OH), Prosolv® SMCC 90 silicified microcrystalline cellulose (JRS Pharma LP, Patterson, NY), Aerosil® R972 Pharma fumed silica (Evonik Industries AG, Essen, Germany), Synpro® magnesium stearate (Ferro Corporation, Walton Hills, OH)

Methods

Extended release caffeine tablets containing 100 or 200 mg active (82% w/w) were manufactured by direct compression. The composition included Carbopol® 971P NF polymer as a matrix forming excipient (0 – 7% w/w), filler (silicified microcrystalline cellulose), glidant and lubricant – Table 1. Tablets were evaluated for physical properties and dissolution was carried out according to the pharmacopeial method (USP 711).

Table 1. Composition of Caffeine Tablets

Formulation	A	B	C	D
Caffeine anhydrous granular	82.0	82.0	82.0	82.0
Carbopol® 971P NF polymer	**-**	**3.0**	**5.0**	**7.0**
Prosolv® SMCC 90 silicified microcrystalline cellulose	17.0	14.0	12.0	10.0
Aerosil® R972 Pharma fumed silica	0.50	0.50	0.50	0.50
Magnesium stearate	0.50	0.50	0.50	0.50
Total	**100**	**100**	**100**	**100**

Target tablet weight: 121.95 mg for 100 mg dose or 243.90 mg for 200 mg dose

RESULTS

All tablets showed acceptable tablet properties – Table 2. Inclusion of 3 and 5% w/w Carbopol® 971P NF polymer reduced the friability of the tablets compared to the immediate release formulation, especially at the lower dose (100 mg). However, increasing the amount of Carbopol® 971P NF polymer to 7% w/w was detrimental, resulting in higher weight variation for the 200 mg dose tablets and lower hardness for the 100 mg dose tablets.

Table 2. Caffeine Tablet Properties

% Carbopol® 971P NF Polymer	0		3		5		7	
Dose (mg)	**100**	**200**	**100**	**200**	**100**	**200**	**100**	**200**
Weight (mg)	120.72	242.39	120.54	242.43	122.97	245.05	121.71	231.87
SD	0.58	0.83	1.13	1.83	1.52	3.02	2.73	13.31
Thickness (mm)	3.64	4.80	3.75	4.84	3.93	4.87	4.12	4.77
SD	0.04	0.05	0.01	0.03	0.03	0.03	0.03	0.10
Hardness (kp)	8.33	11.16	8.13	12.13	8.24	12.74	5.74	11.25
SD	1.61	0.42	1.31	0.88	1.28	2.03	1.20	3.95
Friability (%)	0.291	0.134	0.141	0.095	0.119	0.120	0.205	0.184

Incorporation of Carbopol® 971P NF polymer in the tablets (3 – 7% w/w) imparted extended release properties for up to 12 hours. – Figures 1 – 2.

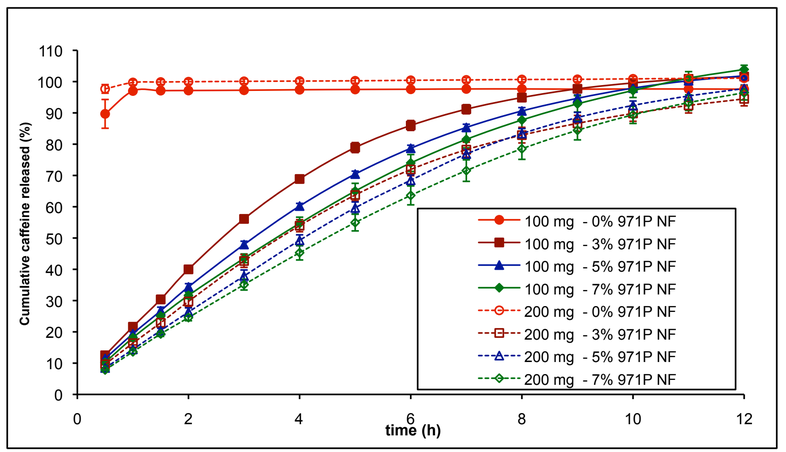

Figure 1. Caffeine release from 100 and 200 mg dose tablets in pH=6.8 USP phosphate buffer

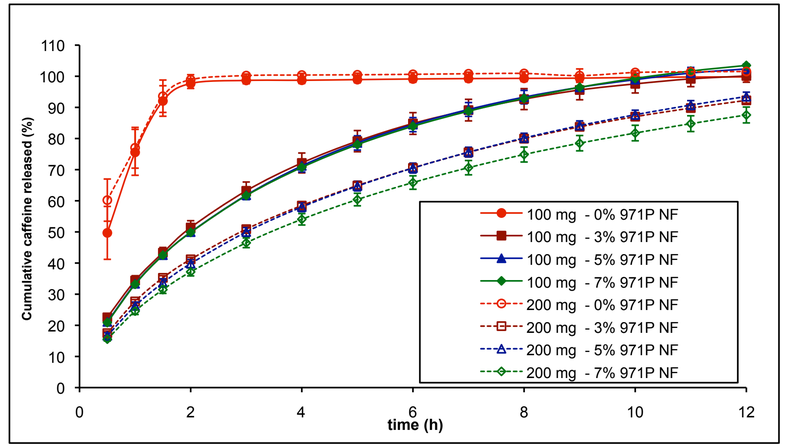

Figure 2. Caffeine release from 100 and 200 mg dose tablets in 0.1N HCl

Carbopol® 971P NF polymer can retard drug dissolution at low levels due to its chemically crosslinked nature and fine particle size (median diameter 2 – 7 microns). The particle size creates a large surface area available for hydration (hence controlling the release), but it can also negatively affect the direct compression process (flowability of the blends). Increasing the polymer level to 7% w/w did not provide significant dissolution benefits compared to lower inclusion levels (3 or 5% w/w) , but it led to higher tablet weight variation. The difference in the ratio area per volume for tablets of 100 mg versus 200 mg dose (0.92 vs. 1.15) resulted in slower release for the higher dose tablets.

CONCLUSIONS

Cost effective caffeine extended release tablets were developed by direct compression, using Carbopol® 971P NF polymer as a matrix forming excipient at a 3 – 5% w/w inclusion level.