

Comparative Evaluation of Tablet Properties prepared with Hydroxypropyl Cellulose and Polyvinylpyrrolidone by Fluidized Bed Granulation Method

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Summary

Hydroxypropyl Cellulose (HPC) is widely used as a high performance binder for wet granulation. In this study, we prepared both high and low drug load tablets of acetaminophen by fluidized bed granulation method using special low viscosity grade of HPC (HPC-SSL) and Polyvinylpyrrolidone (PVP K-30), and carried out comparison of tablet properties and drug release. As a result of comparison, it was suggested that HPC-SSL could provide much more excellent tablet properties with faster drug release than PVP K-30 in the case of high drug formulation.

Introduction

Fluidized bed granulation is well-known as a granulation method which can provide granules with much higher compression formability, and is considered an effective method especially for formulations using poorly compressible drug.

HPC is a water-soluble polymer which is solublized by introducing hydroxypropyl groups that hinder the hydrogen bonding of hydroxyl groups of cellulose. It is widely used as a high performance binder for wet granulation. In this study, we carried out comparison of tablet properties and drug release for high and low drug load tablet prepared by fluidized bed granulation method using HPC-SSL and PVP K-30, which is also widely used as binder for wet granulation, especially outside of Japan. Acetaminophen was used as a model drug.

Experimental Methods

Materials

- HPC-SSL (Nippon Soda Co., Ltd.)
- PVP K-30 (Plasdone K29/32, International Specialty Products)
- Acetaminophen fine powder (Yamamoto Chemical Industries. Co., Ltd.)
- Lactose (200M, DMV International BV)
- Corn Starch (Nihon Shokuhin Kako Co., Ltd.)

High Drug Load Formulation

Ingredients	Compositions (%)				
	60	60	60	60	60
Acetaminophen	60	60	60	60	60
Lactose	24.5	24.5	24.5	24.5	24.5
Corn Starch	10.5	10.5	10.5	10.5	10.5
HPC-SSL	3	5	-	-	-
PVP K-30	-	-	3	5	7
Magnesium Stearate	0.5	0.5	0.5	0.5	0.5

Low Drug Load Formulation

Ingredients	Compositions (%)			
	30	30	30	30
Acetaminophen	30	30	30	30
Lactose	49	49	49	49
Corn Starch	21	21	21	21
HPC-SSL	3	5	-	-
PVP K-30	-	-	3	5
Magnesium Stearate	0.5	0.5	0.5	0.5

Preparation of Tablet

Acetaminophen, Lactose and Corn Starch were pre-mixed in PE bag for 3 minutes and added to the granulator (FL-LABO, FREUND Co., Ltd.), followed by granulation with spraying 8% aqueous solution of binder (HPC-SSL or PVP K-30) at spray speed of 5mL/min and drying. Powder for tablet was prepared by dry-mixing granules of 30 mesh pass and Magnesium Stearate for 30 sec. Laboratory scale rotary tablet press machine (VELA5, KIKUSUI SEISAKUSHO Ltd.) was used to compress tablet at 10kN of compression force. Tablet weight is 200mg and its diameter is 8mm.

Measurement of Tablet Properties

Tablet hardness of 10 tablets per lot was measured by ERWEKA model TBH28 tablet tester. Friability and disintegration time was measured according to JP method. Release rate of acetaminophen was also measured according to JP method and concentration of acetaminophen at each time point was determined by measurement of absorbance at 243nm with UV spectrophotometer.

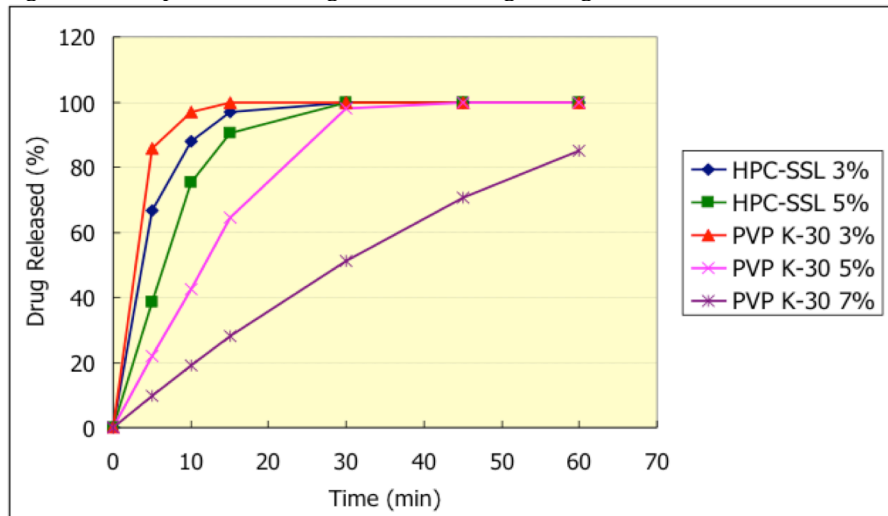
Results and Discussion

Table 1. Comparison of Tablet Properties for High Drug Load Formulation

Type of Binder		HPC-SSL		PVP K-30		
Binder Content (%)		3	5	3	5	7
Tablet Hardness (kgf)		11.2	13.6	7.6	9.1	10.9
Friability (%)		0.2	0.2	0.5	0.4	0.3
Disintegration Time (min)		2.1	6.0	1.3	5.6	18.5

Comparison of tablet properties for high drug load formulation is as shown in Table 1. Tablet prepared with 3% of HPC-SSL showed good enough properties. Tablet prepared with 3% of PVP K-30 showed much lower tablet hardness and much higher friability than HPC-SSL. When PVP K-30 was increased up to 5%, disintegration time was hindered while tablet hardness and friability were still inferior to 3% of HPC-SSL. Also, when PVP K-30 was increased up to 7%, disintegration time was considerably hindered while tablet properties were improved.

Figure 1: Comparison of Drug Release for High Drug Load Tablet



Comparison of drug release for high drug load formulation is as shown in Fig. 1. Tablet with 3% of PVP K-30 showed fastest drug release since its hardness was much lower. When PVP K-30 was increased up to 5% or 7%, drug release was considerably hindered.

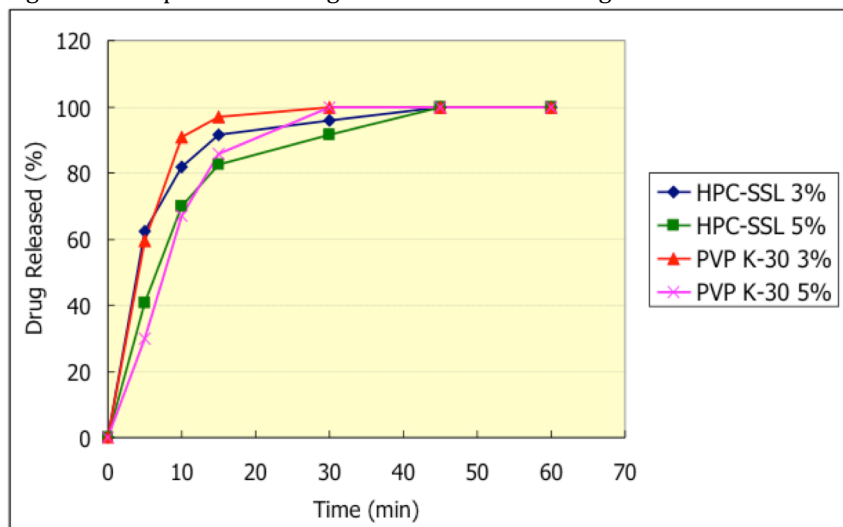
Tablet with 3% of HPC-SSL showed fast drug release while its tablet hardness was much harder, and drug release was not so hindered when HPC-SSL was increased up to 5%.

Table 2: Comparison of Tablet Properties for Low Drug Load Tablet

Type of Binder		HPC-SSL		PVP K-30	
Binder Content (%)		3	5	3	5
Tablet Hardness (kgf)		10.6	14.6	9.7	11.7
Friability (%)		0.2	0.1	0.3	0.2
Disintegration Time (min)		2.3	4.2	1.8	3.7

Comparison of tablet properties for low drug load formulation is as shown in Table 2. Much difference of tablet properties was not seen in the case of 3%. When increased up to 5%, Tablet properties with HPC-SSL improved more than PVP K-30.

Figure 2: Comparison of Drug Release from Low Drug Load Formulation



Comparison of drug release for low drug load formulation is as shown in Fig. 2. In the case of the same contents, much difference of drug release profile was not seen.

Conclusion

In the case of high drug load formulation, HPC-SSL was found to provide more excellent tablet properties with lower usage level than PVP K-30. It was shown that PVP K-30 requires much higher usage level than HPC-SSL to get excellent tablet properties, and that at this higher usage level the disintegration of tablet and drug release from the PVP K-30 tablet became considerably hindered.

It is suggested that HPC-SSL is a well-balanced binder which can provide excellent tablet properties without hindering drug release.

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This data was originally presented at the American Association of Pharmaceutical Scientists Annual Meeting (AAPS 2013), Chicago USA.

