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

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## SUMMARY

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. 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 is suggested that HPC-SSL can provide better tablet properties with faster drug release than PVP K-30 in the case of high drug formulation.

## INTRODUCTION

Hydroxypropyl Cellulose (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 special low viscosity grade of HPC (HPC-SSL) and Polyvinylpyrrolidone (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.)
- Magnesium Stearate (Wako Pure Chemical Industries, Ltd)

### High Drug Load Formulation

| Ingredients | Compositions (%) | | | | |
|---|---|---|---|---|---|
| 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 |
| Mg Stearate | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |

### Low Drug Load Formulation

| Ingredients | Compositions (%) | | | |
|---|---|---|---|---|
| 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 |
| Mg 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 seconds.

Laboratory scale rotary tablet press machine (VELA5 0312SS2MZ, KIKUSUI SEISAKUSHO Ltd. was used to compress tablet at 10kN of compression pressure. Tablet weight is 200mg and its diameter is 8mm.

### Measurement of Tablet Properties and Dissolution

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

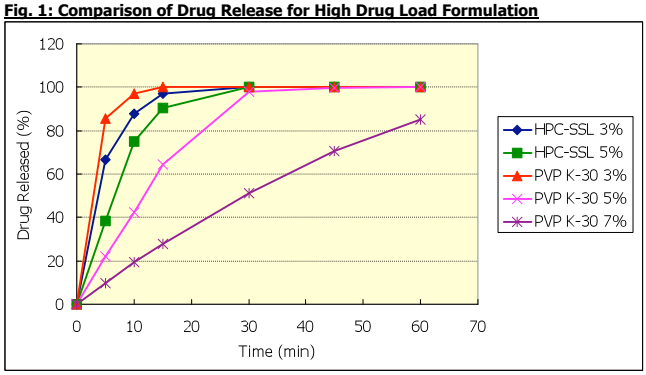
**Table 1. Comparison of Tablet Properties for High Drug Load Formulation**

| 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.

## RESULTS AND DISCUSSION (Continued)

**Fig. 1: Comparison of Drug Release for High Drug Load Formulation**




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.

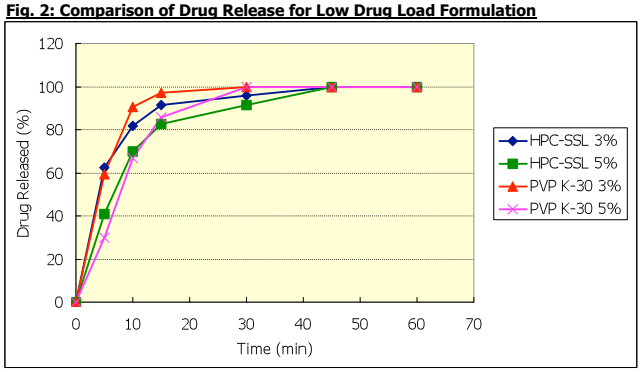
Tablet with 3% of HPC-SSL showed fast drug release while its tablet hardness was much harder, and drug release was not so hindered when HPC-SSL was increased up to 5%.

**Table 2. Comparison of Tablet Properties for Low Drug Load Formulation**

| 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.

**Fig. 2: Comparison of Drug Release for 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.

## CONCLUSIONS

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 becomes 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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