Lubricant sensitivity of starch based disintegrants

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INTRODUCTION

Starch and starch derivatives, such as sodium starch glycolate, are extensively used disintegrants for tablets and capsules. However, starch is considered to be sensitive against film forming on its surface during pharmaceutical manufacturing. Lubricants like Mg stearate could harm its functional properties such as tableting or disintegration [1]. Unlike starch, the disintegration efficiency of sodium starch glycolate (SSG) has been found to be nearly independent from possible hydrophobic films on its surface [2]. New trials with potato starch and modified potato starch (SSG) should contribute for a better understanding.

MATERIALS & METHODS

MATERIALS: Commercial potato starch (potato starch supra NP) and commercial Sodium Starch Glycolate GLYCOLYS® and GLYCOLYS® LV (all Roquette Frères, France) and Magnesium stearate (Bärlocher GmbH, Germany) where used without further purification. All excipients conform to the current Pharm. Eur. monographs.

TABLETING AND TABLET ANALYSIS: Dicalcium phosphate was blended with the selected disintegrant level (0.5 up to 4%) and 0.5% Magnesium stearate as lubricant for the requested time. A Turbula mixer (Type T2C, Willy A. Bachofen AG, Switzerland) was used, rotation speed 75 RPM per min. Biplane tablets (diameter 10 mm) were produced on a pneumo-hydraulic press FlexiTab® 2080 (Röltgen GmbH, Solingen, Germany). The crushing strength has been measured with TBH 210WTD (Erweka GmbH, Germany).

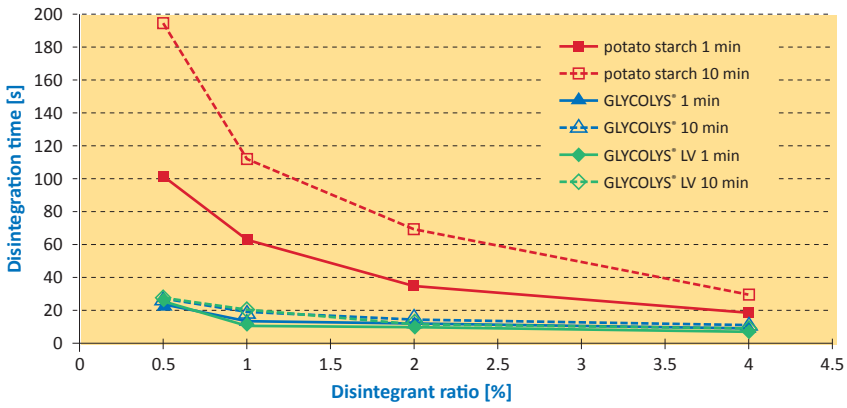
The disintegration time according to the Pharm. Eur. methods was calculated as average of 8 measurements (Erweka ZT 72, Erweka GmbH, Germany). In parallel, the tablet swelling and disintegration has been measured with novel method using a texture analyzer TA HDi (Winopal GmbH, Germany). Tablets are placed in a specific punch-die-combination and wetted with 60µl of water. The tablet swelling is recorded against an imposed punch force of 0.5 N. Results can be expressed as maximum swelling or as mean swelling speed (displacement/ time [mm s-1]). Details are given in [3].

The powder wettability with water has been measured according to Pharm. Eur. 2.9.45 (Washburn principle), using a K100 tensiometer (Krüss, D-Hamburg). Analysis of the wettability of tablet surfaces were done with the Easy Drop System (Krüss, D-Hamburg), using the contour analysis of water droplets.

RESULTS & DISCUSSION

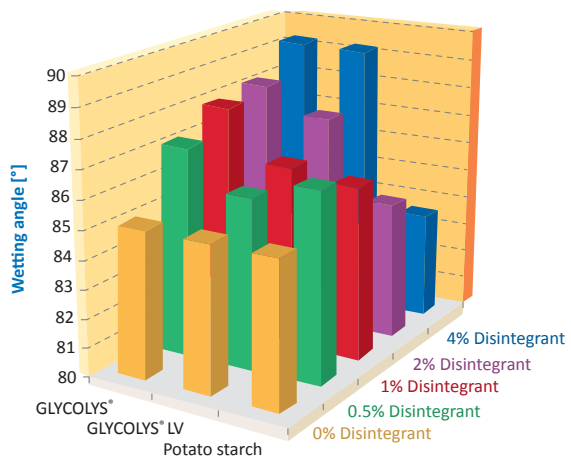
Both potato starch and modified potato starch (SSG) are effective disintegrants for the phosphate tablets. 4 to 5 fold more native starch is needed to reach the same disintegration time. Prolonging the mixing time from 1 to 10 min demonstrates negative impact of film forming on the disintegration and hardness of the tablets, containing potato starch (see **figure 1**), but not on tablets with SSG.

Figure 1. Disintegration time of tablets, containing different disintegrants (smooth line after 1 min mixing, dotted line after 10 min mixing).



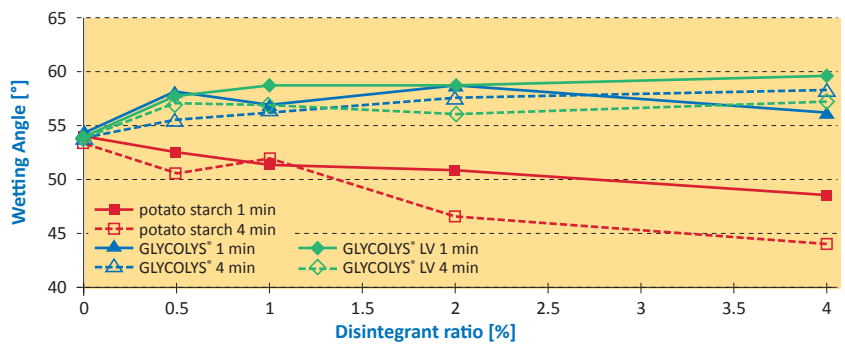
In consequence the wettability of powder blends before compression has been measured. It is modulated by the choice of the disintegrant. The presence of native potato starch renders the blends more hydrophilic when increasing the mixing time or starch ratio. This is caused by the preferred interaction between starch and stearate, without affecting the phosphate. A preferred interaction of SSG and magnesium stearate is not detectable (see **figure 2**).

Figure 2. Contact angle of powder blends before compression containing different ratios of disintegrants. Mixing time 1 min.



Analyzing tablet surfaces results in the same finding. Native starch renders the total tablet surface more and more hydrophilic. SSG does not preferred bind Mg Stearate on its surface. The wettability of complete tablet surface remains therefore nearly unchanged when adding stearate (see **figure 3**).

Figure 3. Wettability of tablets containing 0.5% Mg stearate and different ratios of disintegrants. Mixing time 1 min or 4 min before compression.



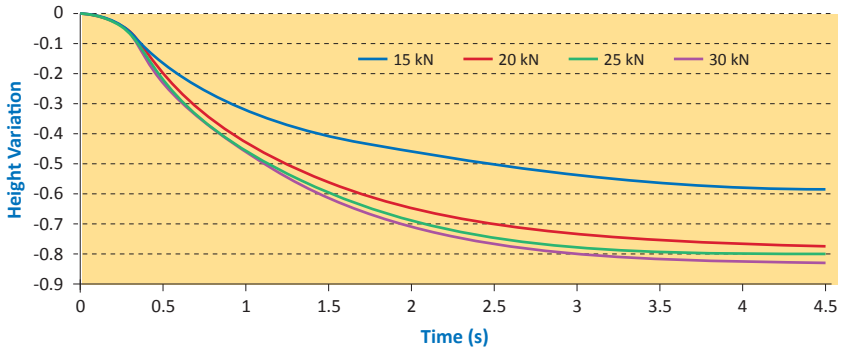
Studying the tablet swelling in the texture analyser according [3] showed a big difference in the swelling performance of the disintegrants. Potato starch turned out to be significantly weaker that SSG (see **table 1**). GLYCOLYS® LV resulted in better findings than GLYCOLYS®.

Table 1. Swelling properties of tablets made with 2% disintegrant and 0.5% Mg stearate (compression force 25 kN, n= 10) against an imposed force of 0.5 kN.

	Mean swelling speed [mm/s]	Increase of the tablet height [%]
Potato starch	0,0126 ± 0,0049	4,93 ± 1,88
GLYCOLYS®	0,0360 ± 0,0046	25,43 ± 3,32
GLYCOLYS® LV	0,0613 ± 0,0190	26,72 ± 13,96

Increasing the compression force during tableting yielded into higher swelling speed combined with a more important gain of tablet heights (see **figure 4**). Higher tablet porosity does not permit disintegrants to develop optimal performance. Empty spaces are just filled up but with less effect on the tablet disintegration. The found higher tablet disintegration speed in presence of SSG is not in direct correlation with the findings about the wettability of the tablet surface. Obviously, more hydrophilic tablet surfaces do not guarantee faster disintegration. The swelling performance of the selected excipient is crucial for its activity.

Figure 4. Swelling of tablets against an imposed force of 0.5 kN, Example 2% GLYCOLYS® as disintegrants in tablets made with different compression forces.



CONCLUSION

Unlike potato starch, Sodium starch glycolate turned out to be non sensible against film forming, e.g. caused by extensive blending. Studying the wettability of powder blends and tablets demonstrated clearly that Mg Stearate is primary bound on the surface of potato starch, impairing its efficiency as disintegrant. Sodium starch glycolate does not face the same draw back. The surface affinity of stearate is low. This may be caused by the presence of hydrophilic crystals on the surface, preventing a complete covering of the surface. Additionally the strong volume increase of SSG during its swelling creates new and fresh surface without hydrophobic barriers [2]. Increasing the tablet hardness and therefore having a reduced tablet porosity assist the efficiency of starch based disintegrants.

REFERENCE

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