Determining the Minimum Amount of Functional Coat to be Applied to Gain Taste Masking Functionality and Investigating Whether Tablet Shape or Scale is Influencing the Result

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Purpose

In the realm of functional film-coating, the coating level typically corresponds to the quality of the delivered dissolution profile. Hereby, one has to differentiate two principles:

a) Functionality dependent on layer thickness (e.g. sustained release, moisture protective coats)
b) Functionality not dependent on layer thickness (e.g. gastric resistant, taste masking functionality)

For the first example, functionality obeys Fick's first law (permeation); whereas the latter application mainly requires a homogenous and completely closed coat.

Kollicoat® Smartseal 30 D is one of the latest polymers delivering two functionalities: moisture protection and taste masking [1]. The aim of this work was to evaluate the coating level required to provide taste masking functionality. This investigation was done with two differently shaped tablets (round and football shaped). The caffeine containing tablets were coated in small and large scale side vented pan coaters (Perfima).

Materials and Methods

Materials

The following components were used for the core formulation (Table 1): Caffeine (gran. 0.2–0.5), Ludipress® LCE, Kollidon® CL-F, Kollidon® VA64 (all BASF) and magnesium stearate (Baerlocher).
The following excipients were used for the coat formulation (Table 2): Kollicoat® Smartseal 30 D, iron oxide red and FD&C Blue No. 1 (all BASF), triethyl citrate (Jungbunzlauer Ladenburg), buthylene hydroxy toluene (BHT) (Sigma-Aldrich), talc (Merck).

Table 1: Composition of the core

Ingredients	Quantity [%]
Caffeine, gran. 0.2–0.5	15.5
Ludipress® LCE	74.0
Kollidon® CL-F	5.0
Kollidon® VA64 fine	5.0
Magnesium stearate	0.5

Table 2: Composition of the coat

Ingredients	Quantity [%]
Kollicoat® Smartseal 30 D	51.75
Triethyl citrate	6.73
Buthylene hydroxy toluene	0.52
Talc	38.00
Colorant	2.00
FD&C Blue No. 1	1.00

Methods

Coating process

Round and football-shaped tablets were coated. The dispersion was applied using the I.M.A. equipment Perfima Lab (with medium drum – 30 L) and Perfima 200 (200 L).

Table 3: Coater settings (process parameters)

Parameters	Perfima Lab	Perfima 200
Batch size		
round shaped cores	21.8 kg	145.6 kg
football shaped cores	20.2 kg	134.4 kg
Volume	30 L	200 L
Drum speed	8 rpm	5 rpm
Inlet air temperature	55 °C	55 °C
Inlet air quantity	1,000 m³/h	2,800 m³/h
Spray rate	45 g/min	180 g/min
Process time		
round shaped cores	104 minutes	173 minutes
football shaped cores	91 minutes	152 minutes

Photometrical measuring

To allow a distinct investigation on the coating level, the individual amount of applied coat was determined via photometrical measuring of the indicating colorant FD&C Blue No. 1 [2, 3].

Sample preparation

All samples were stored for 4 hours at 60 °C to make sure that the coat is perfectly formed. This procedure delivers the more reliable results.

Dissolution testing

For the dissolution test standard equipment according to Ph. Eur. was used. As the taste masking functionality is to be delivered in the oral cavity, phosphate buffer (pH 6.8) was used as dissolution media. Hereby, the criterion for a fully functional coat was that no drug release was seen for a period of 2 hours. To increase the sensitivity of the test, 5 tablets were tested in parallel in one dissolution vessel.

Results and Discussion

The film-coating process with Kollicoat® Smartseal was easy and could be conducted without any problems in all scales. Even though there was no tendency for tackiness moderate spray rates were chosen to allow a high content uniformity of the applied coat. With low spray rates, spray losses are certainly an issue in every film-coating process. In order to perform a proper interpretation of the results, the actual coating level of each sample was determined [3]. In the following dissolution diagrams both theoretical and actual coating level (the latter one is in brackets) are indicated.
Keeping standard deviation in mind, it was interesting to see that neither scale nor tablet shape seemed to have an impact on the resulting spray losses (Figure 1). As a rule of thumb, about 10 % spray losses could be considered as typical.
In order to obtain an effect on drug release, a coating level of just 1.5 to 2.5 mg/cm² had to be applied. Tablets bearing this amount of coat were found with a drug release being distinctively delayed. With a coating level of 2.5 mg/cm² the first amounts of caffeine could be detected at a dissolution time of about 20 minutes (Figure 2, Figure 3, Figure 4, Figure 5). This delay in drug release could already be sufficient for some applications.

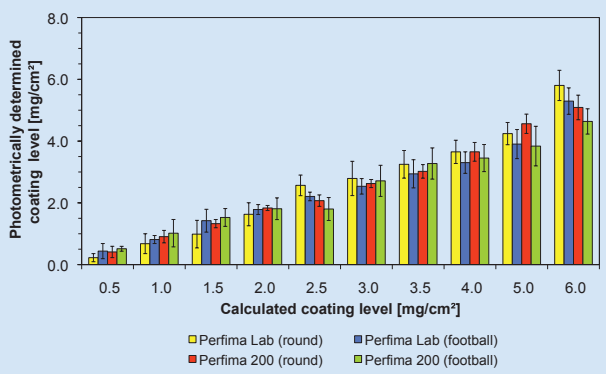

Figure 1: Comparison of calculated and photometrically determined coating level (mean ± s, n = 5)

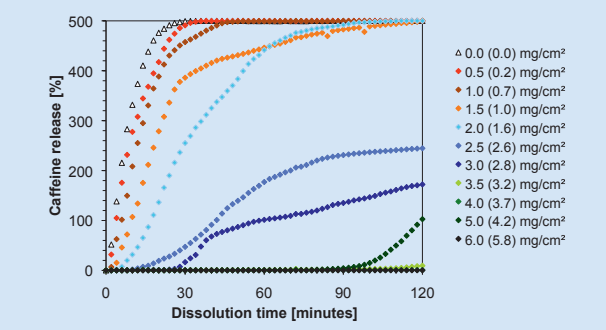

Figure 2: Perfima Lab coater – dissolution profiles (pH 6.8) of round shaped tablets bearing different coating levels, whereas theoretical and in brackets analytically determined coating level are indicated (mean, n = 5)

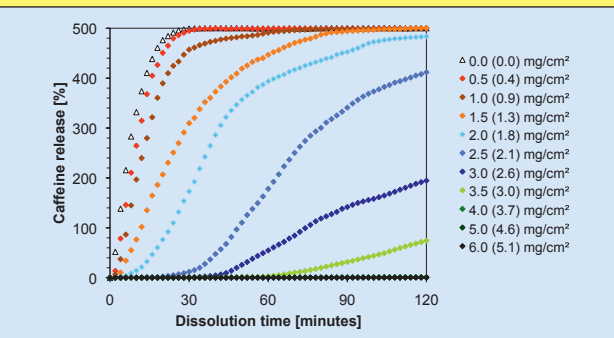

Figure 3: Perfima 200 coater – dissolution profiles (pH 6.8) of round shaped tablets bearing different coating levels, whereas theoretical and in brackets analytically determined coating level are indicated (mean, n = 5)

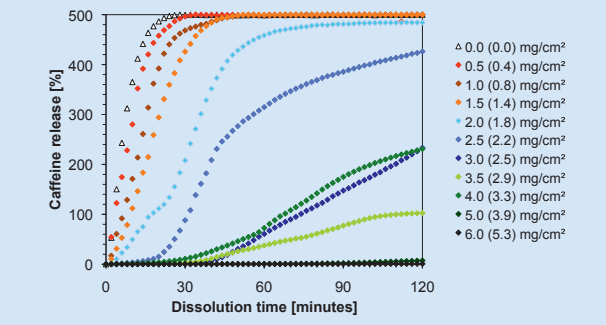

Figure 4: Perfima Lab coater – dissolution profiles (pH 6.8) of football shaped tablets bearing different coating levels, whereas theoretical and in brackets analytically determined coating level are indicated (mean, n = 5)

To ensure a compleately, durably sealed core, 3.5 mg/cm² Kollicoat® Smartseal formulation had to be applied. With this coating level, no drug release at all could be detected.
Regarding uniformity of the applied coat, it seemed that the large scale batches (Figure 3, Figure 5) yielded higher homogeneity. A coating level of less then 4 mg/cm² was still preventing the caffeine from being released.
Even though Kollicoat® Smartseal has to be regarded as a functional polymer, it is eventually used for instant release application. This means, as soon as the tablet is been placed in an acidic environment (pH value < 5.5), the polymer gets easily soluble. This was indicated by a fast dissolution in acidic media (Figure 6). Hardly any effects of coating level on dissolution time could be found.

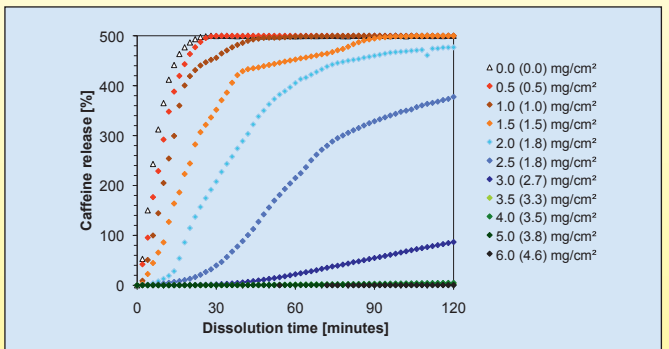

Figure 5: Perfima 200 coater – dissolution profiles (pH 6.8) of football shaped tablets bearing different coating levels, whereas theoretical and in brackets analytically determined coating level are indicated (mean, n = 5)

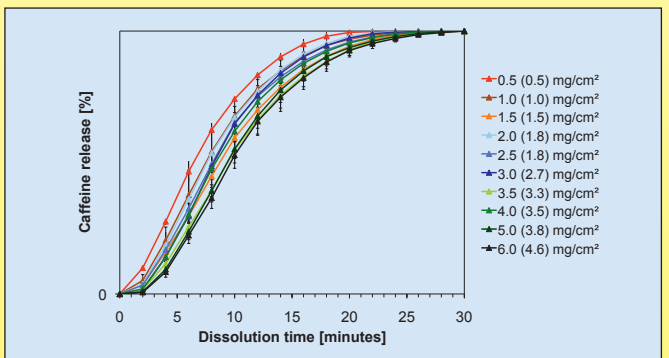

Figure 6: Perfima 200 coater – dissolution profiles (pH 1.0) of football shaped tablets bearing different coating levels, whereas theoretical and in brackets analytically determined coating level are indicated (mean, n = 3)

Conclusion

It could be seen that quite low coating levels of about 1.5–2.5 mg/cm² already supply a distinctive reduction in drug release. For instance, at pH 6.8 a delay in drug release of 20 minutes was achieved with a coating level of 2.5 mg/cm². However, 3.5 mg/cm² had to be applied to seal the tablet durably. Furthermore, these film-coated tablets did not release any drug at all during the testing time of 2 hours.
Nevertheless, as soon as the pH media was altered to pH 1.0 instant drug releases could be seen. Even with high coating levels of about 5 mg/cm², 100 % drug release was found within 25 minutes.
Most importantly, all the results were found to be independent of tablet shape and batch size.

References

[1] Kolter, K., Guth, F., Angel, M.; Physicochemical characteristics of a new aqueous polymer; AAPS Annual Meeting and Exposition, November 14–18, 2010, New Orleans, Louisiana, U.S.A.
[2] Agnese, T., Cech, T., Guth, F.; Developing a photometric method to determine the amount of film-coating material applied onto individual tablet cores; 3rd PharmSciFair; June 13–17, 2011; Prague, Czech Republic
[3] Agnese, T., Cech, T., Funaro, C., et al.; Evaluating different methods to determine the amount of applied coating material onto a tablet; 3rd PharmSciFair; June 13–17, 2011; Prague, Czech Republic

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