Investigating the benefits of delivering gastric resistant functionality to a tablet by applying a colourless top-coat based on Kollicoat® MAE 30 DP

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INTRODUCTION

In the field of gastric resistant film-coating, a lot of obstacles can occur during formulation development. Some pharmaceutical actives (e.g. omeprazole) are prone to interactions with the functional polymer poly(methacrylic acid-co-ethyl acrylate) (MAE). Yet, one should consider that the coating material itself is also vulnerable to interactions with excipients (such as pigments or colourants) present in the coating formulation. This work was set to investigate whether the gastric resistant functionality can be applied with a colourless film, coated onto a tablet bearing a coloured instant release sub-coat.

MATERIALS AND METHODS

Materials

As gastric resistant film forming polymer, Kollicoat® MAE 30 DP (BASF) in combination with the plasticiser triethyl citrate (TEC) (Jungbunzlauer) was chosen.

As sub-coat, seven formulations (varying in colour) of a Kollicoat® IR (BASF) based ready-to-use coating system were applied, with a weight gain of 3.5%.

The following components were used for the core formulation (Table 1): Caffeine gran. 0.2-0.5 (Siegfried), Ludipress® LCE, Kollidon® CL-F, Kollidon® VA64 (all BASF SE), and magnesium stearate (Baerlocher).

Table 1.
Composition of the cores.

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

Coating process

As coating equipment, the XL Lab 01 (Manesty) was used. The coater was assembled with a mid-sized drum (diameter 480 mm). As nozzle, the OptiCoat gun with an orifice diameter of 0.8 mm was used.

Round-shaped tablets with a diameter of 8.0 mm were coated according to schema (Table 2).

Table 2.
Set-up coating trials.

	Sub-coat	Top-coat
Batch size	4.0 kg	4.0 kg
Drum speed	12 rpm	12 rpm
Inlet air temperature	65°C	55°C
Inlet air quantity	450 m³/h	450 m³/h
Spray rate	13 g/min	13 g/min
Atomising pressure	1.8 bar	1.8 bar
Pattern air pressure	1.8 bar	1.8 bar

MAE was applied as top-coat with five coating levels: 3, 4, 6, 8 and 12 mg/cm². The test was conducted with various amounts of plasticiser (Table 3).

Table 3.
Plasticiser content in the top-coat formulations.

Plasticiser content	
related to polymer content [%]	present in the coat [%]
10	9
15	13
20	17
25	20

Dissolution testing

The dissolution test (n=3) was conducted for the first 2 hours at pH 1.1 (HCl, 0.08 mol/L; volume 880 mL) and 37 °C (± 1 K). A paddle speed of 50 rpm was set. By adding 20 mL of a concentrated sodium phosphate buffer system, the pH value was adjusted to 6.8 for an additional 60 minutes time. The drug release was determined photometrically via online measuring.

Colour measuring

For colour measuring (n=10) the Datacolor 400 (Datacolor) was used. The experimental set-up was: aperture USAV, light source D65 and observe angle 10°. The colourimetric values were recorded as L*a*b* values of the CIELAB colour space.

To compare the effect of the MAE top-coat on the hue, the colour reading of the sub-coated tablet was compared with the ones bearing the different top-coats (Table 3). The appraisal was done on basis of the delta E value (Figure 1).

Figure 1.
Equation for calculating the ΔE-value.

$$\Delta E = \sqrt{\left(L_1^* - L_2^*\right)^2 + \left(a_1^* - a_2^*\right)^2 + \left(b_1^* - b_2^*\right)^2}$$

Gloss measuring

The gloss-value (n=5) was determined using a Novo Curve 60° (Rhopoint Instruments).

RESULTS AND DISCUSSION

Seven batches with one base colour each were coated. After uniting all tablets, every individual batch used for the top-coat trial bore an equal number of tablets of each colour. TEC was chosen as a well-suitable plasticiser for MAE in this investigation [1]. Four different top-coat formulations were applied (Table 3, Figure 2).

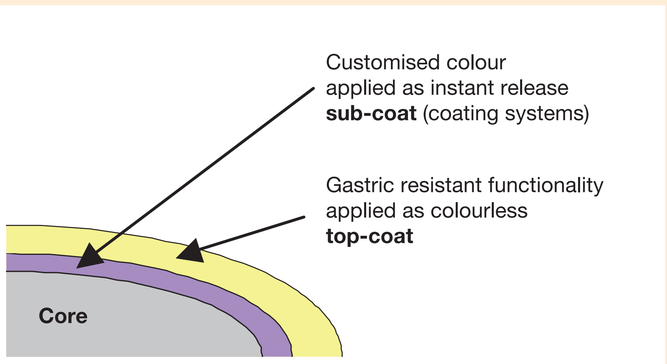

Figure 2.
Scheme of the sub- and top-coated core.

Only a plasticiser level of 10% resulted in a brittle film showing cracks immediately after the coating process (Figure 3). All other concentrations were found to be suitable. Interestingly, even though used with a concentration of 25% maximum, the resulted coat did not appear tacky.

Figure 3.
Cracks in the MAE top-coat, formulation containing 10% TEC.

All applicable plasticiser concentrations of 15, 20 and 25% delivered full functionality (Figure 4). No drug release was found during the first two hours of the dissolution testing. After altering the pH-value to 6.8, an instant drug release with hardly any lag-time was observed. More important, the actual drug release was found to be scarce depending on the coating level of MAE. Even with 12 mg/cm² MAE applied, caffeine was released rapidly.

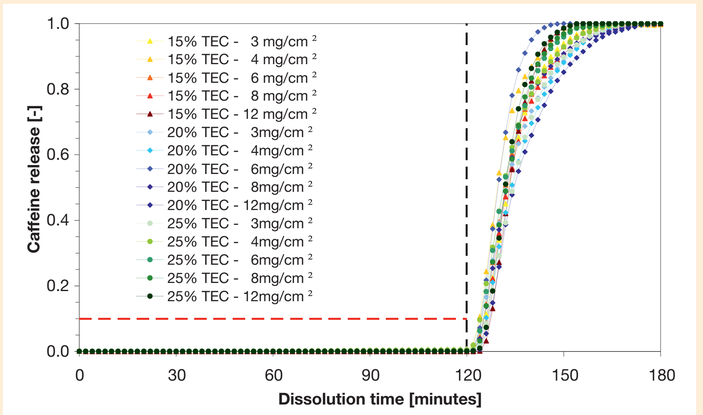

Figure 4.
Dissolution profiles of tablets bearing different coating levels of three different MAE formations.

The impression of the initial core colour was somehow affected by the application of the MAE top-coat whereas the highest impact could be seen for Sunset Yellow (Figure 5). However, the change in colour appearance was found to be hardly dependent on coating level and plasticiser content. The same applies for the gloss values which also remained unchanged when different coating levels of MAE were applied as top-coat (Figure 6).

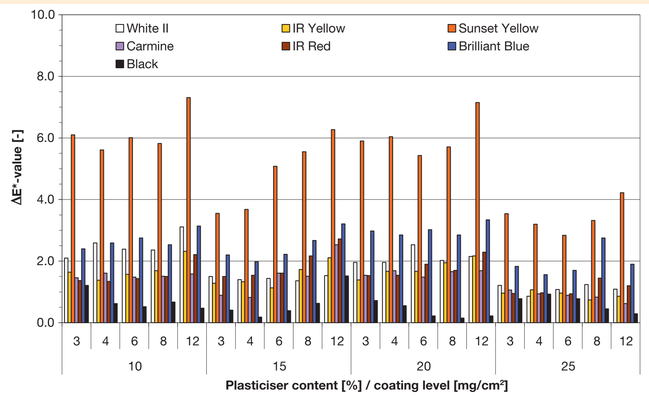

Figure 5.
Delta E-values, comparing the final hue with the colour impression of the sub-coated core.

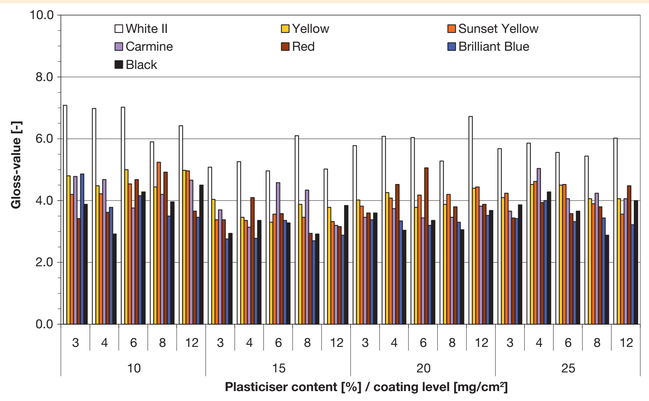

Figure 6.
Gloss-values of cores bearing different coating levels of MAE top-coat.

CONCLUSION

The application of a coloured sub- and a colourless functional-coat is an easy way of preventing potential interactions between API and film-forming polymer. By using the functional polymer without any further excipients but plasticiser, the benefits of the coloured coating systems (such as colour matching [2]) can be utilised as well.

Applying MAE as a colourless top-coat provides an easy coating process and reliable drug release functionality.

REFERENCES

[1] V. Bühler; Kollicoat® Grades – Functional Polymers for the Pharmaceutical Industry; BASF SE, January 2007

[2] K. Kolter, A. Maschke, T. Schmeller; Color matching for instant release coated tablets; 7th PBP World Meeting; March 8 – 11, 2010; Valletta, Malty

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