

# Effect of Kollicoat Protect Top-coat on Long-Term Physical Stability of Enteric Coated Softgels

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## OBJECTIVES

Enteric coated softgels tend to agglomerate when stored at high temperature/RH conditions. This study evaluated the effect of a Kollicoat Protect top-coat on the physical stability of enteric coated softgels stored at 40°C/75% RH (open dish and sealed HDPE bottles). Stability was measured by changes in agglomeration, softgel appearance, hardness, brittleness, and/or acid resistance in a disintegration test.

## METHODOLOGY

Placebo softgels were manufactured by Catalent Pharma Solutions, Somerset, NJ. The fill was MCT. The shell consisted of High Bloom Gelatin, sorbitol, glycerine and FD&C Yellow #6.

Kollicoat MAE30DP was used as the enteric coating polymer (1:1 methacrylic acid-ethyl acrylate copolymer in the form of 30% dispersion in water), TEC as plasticizer. Kollicoat Protect was used as a top coat. Softgels were coated by BASF Corporation in a perforated pan coater.

Coated softgels were packaged into 120ml glass jars with loose lids (open dish study) and induction-sealed HDPE bottles (50 count, sealed HDPE bottle study) and stored at 40°C/75% RH.

The following tests were applied:

Test	Number of Softgels Tested	Target Criteria
Appearance		Report for information
Hardness	5	Report for information
Burst Strength	10	Report for information
Impact Test (brittleness)	10	Report for information
Disintegration time in 0.01N HCl USP <701> apparatus, no discs.	6	No rupture in 60 mins
Disintegration time in pH 6.8 phosphate buffer, no discs, USP <701> apparatus.	6	Report for information

All physical testing was performed on softgels stored in HDPE bottles.

## RESULTS

Table 1 Data Summary

Sample	Time Point (Months)	Coating Appearance	Average Hardness (N)	Burst Strength		Disintegration Time in 0.01N HCl (min)	Disintegration Time in pH 6.8 (min)	Impact Testing (S: Shattered, B: Broken, C: Cracked, I: Intact)								
				Mean (kg)	Number of Intact Softgels			7.5 cm				5.0 cm				
						S	B	C	I	S	B	C	I			
No Top Coat	0	Coating free of defects	11.4	2.86	0	N/A	29.2	0	10	0	0	0	0	5	5	0
	0.25	Agglomeration	7.6	38.55	4	N/A	28.7	0	8	2	0	0	0	5	4	1
	0.5	Agglomeration	7.6	24.81	2	5-7	N/A	8	2	0	0	0	0	9	1	0
	1	Agglomeration	6.1	27.49	5	5-10	N/A	8	2	0	0	0	0	7	3	0
	2	Agglomeration	6.1	39.68	5	8-15	N/A	6	4	0	0	0	0	3	7	0
	3	Agglomeration	5.1	42.27	4	20	N/A	0	2	3	0	0	0	1	4	0
	6	Agglomeration	4.3	N/A	N/A	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kollicoat Protect Top Coat	0	Coating free of defects	11.7	6.36	0	N/A	30.4	0	0	10	0	0	0	0	10	0
	0.25	Coating free of defects	9.5	49.29	6	N/A	26.4	0	0	10	0	0	0	0	10	0
	0.5	Coating free of defects	9.3	48.19	9	N/A	25.0	0	0	10	0	0	0	0	10	0
	1	Coating free of defects	8.0	44.76	9	N/A	26.2	0	0	10	0	0	0	0	10	0
	2	Coating free of defects	7.8	>50	10	N/A	26.8	0	0	10	0	0	0	0	10	0
	3	Coating free of defects	7.4	>50	10	N/A	19.7	0	0	0	10	0	0	0	0	10
	6	Coating free of defects	6.6	48.13	9	N/A	18.2	0	0	3	7	0	0	0	0	10

### Appearance

1 week at 40°C/75% RH, open dish      2 weeks at 40°C/75% RH, open dish



Figure 1. Average Hardness Results (N)

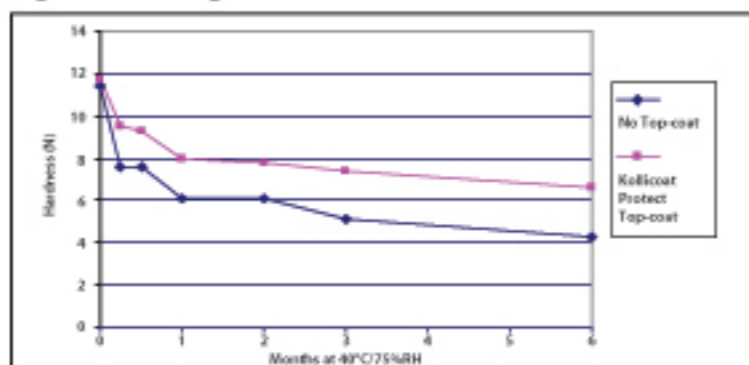
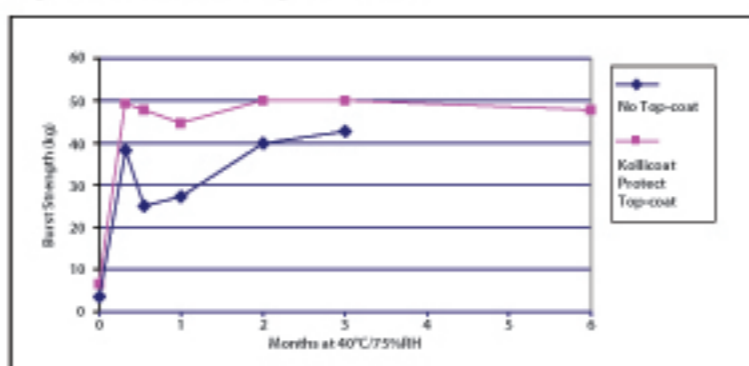


Figure 2. Burst Strength Results



\* High softgel-to-softgel variability observed.

Figure 3. Impact Test Results (No Top-Coat, height 7.5 cm)

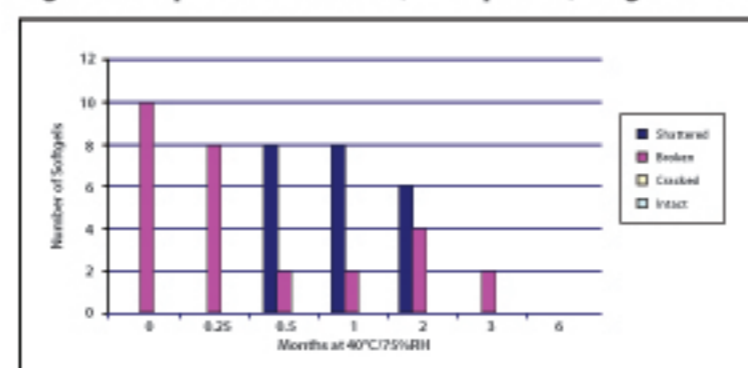


Figure 4. Impact Test Results (Kollicoat Protect Top-Coat, height 7.5 cm)

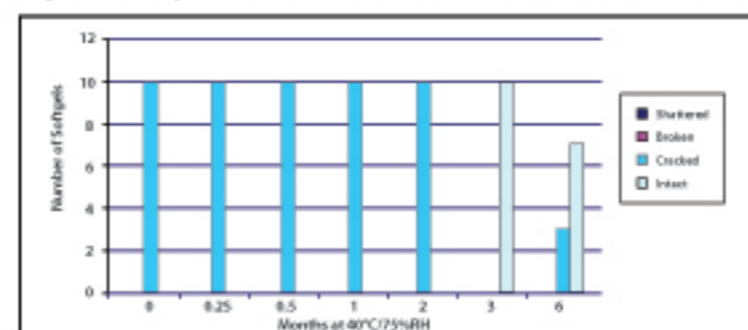
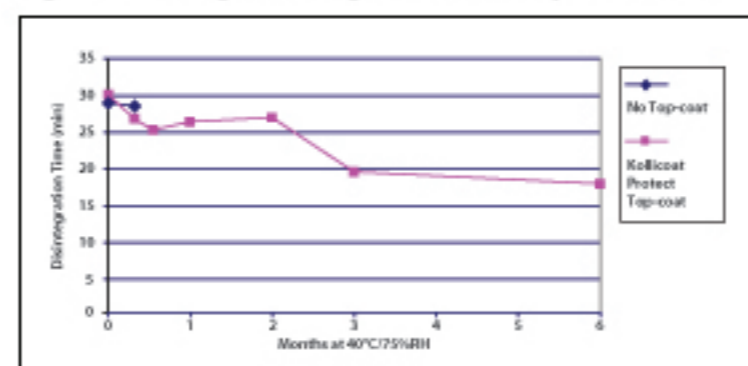


Figure 5. Average Disintegration Time in pH 6.8 (min)



\* Softgels without Kollicoat Protect top-coat failed disintegration testing at 2 weeks and all other time points due to agglomeration that resulted in a loss of enteric properties.

## CONCLUSIONS

Softgels without top-coat began to agglomerate after 1 week. Kollicoat Protect prevented agglomeration in both open dish and induction-sealed HDPE bottles.

Hardness of both prototypes dropped during storage at 40°C/75%RH. Softgels with Kollicoat Protect top-coat remained harder than softgels without the top coat, likely due to moisture barrier properties of Kollicoat Protect.

Burst Strength of both prototypes at the initiation of the study was relatively low. During stability, the burst strength of both prototypes increased significantly, presumably due to moisture migration into the softgel and its plasticizing effect.

Impact testing showed that softgels with a Kollicoat Protect top-coat tended to be more robust.

Disintegration time of both samples in pH 6.8 was similar at the beginning of the study. Softgels without a top-coat, stored in HDPE bottles, agglomerated after 2 weeks. Agglomeration caused the softgels to lose their enteric properties.

Softgel agglomeration and changes in other physical properties are common, especially at high temperature and RH. Applying force to pull the softgels from the agglomeration for ingestion or testing can result in the loss of enteric properties. Kollicoat Protect top-coat may be used to prevent softgel agglomeration and improve physical stability.