Comparison of Three Phases of Continuous Coater Operation during Application of High Opacity Coating and High Gloss Coating onto Multivitamins

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Introduction

There has been an increase in consumer preference for clean label ingredients in dietary supplements and nutritional products. Nutrafinish®, TiO2 (titanium dioxide) Free Coating is a calcium carbonate-based film coating system that satisfies the high opacity and aesthetic requirements of the nutritional market and Nutrapure™, Certified Organic Coating provides a high gloss aqueous coating system. Both coatings are designed for the dietary supplement market where products are often manufactured and coated in high volumes. Continuous coaters are well suited to accommodate the high throughput requirements of nutritional manufacturers. The purpose of this study was to demonstrate the application of Nutrafinish TiO2 Free and Nutrapure in a single pass continuous coating method onto multivitamin tablets (1000 mg).

The objectives of this study were to:

- Sequentially apply two functionally different nutritional coating systems to multivitamin tablets, with different solids concentrations, using a single continuous coating process in a DRIACONTI-T continuous coating machine.
- Compare the appearance of multivitamin tablets during start-up, continuous and shut-down phases of the continuous coating process.

Methods

The coating was conducted in a DRIACONTI-T continuous cycled coating machine (Driam GmbH, Germany). The coating machine was equipped with a rotating, perforated 100 cm diameter drum, divided into 7 individual coating chambers using 30 cm high separating walls, spaced 22 cm apart (Figure 1). During the continuous coating process, “mini-batches” were transferred from chamber to chamber, where the required amount of film coating for each segment was applied. A pneumatically controlled flap facilitated batch-wise tablet movement through the length of the pan. For this study, 18 kg of multivitamin tablets (1000 mg) were transferred from a pre-warming hopper into the first coating chamber. During the coating process, a yellow-pigmented formulation of Nutrafinish TiO2 Free was applied at 17% solids concentration to a recommended 3% weight gain (WG) in chambers #1-5 (0.6% WG per chamber) with approximately 100 g tablets sampled after completion of coating in chamber #5. The Nutrapure clear was applied at 10% solids concentration to a 0.6% WG in chambers #6-7 (0.3% WG per chamber). The coating process parameters used are shown in Table 1.

Figure 1. Schematic of the Driaconti-T Coating Process (modified from Cunningham et al, 2018)

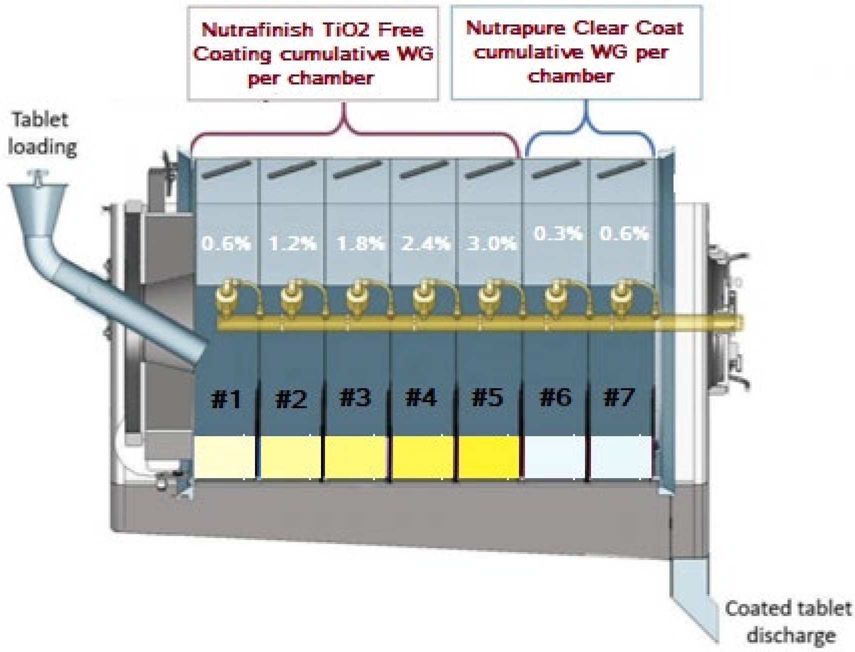

Table 1. Coating Process Parameters

Process Parameters	Nutrafinish	Nutrapure
Load per chamber (kg)	18	
Process air volume (m^3/h)	2060	
Inlet temperature (°C)	60	
Exhaust temperature (°C)	45-54	
Product temperature (°C)	42-46	
Atomizing air pressure (bar)	1.2	
Pattern air pressure (bar)	0.8	
Pan speed – coating (rpm)	8.0	
Pan speed – product transfer (rpm)	2.0	
Coating time per cycle (min)	13.5	
Product transfer time per cycle (min)	1	
Total tablet throughput rate (kg/hr)	80	
Spray rate per gun (g/min)	47	40
Coating solids concentration (%w/w)	17	10
Weight gain (%)	3	0.6

The machine operation was divided into the following three phases:

1. Start-up Phase: at least one of the first six chambers was operational (#1-6) until full
2. Continuous Mode: all seven chambers were operational (#1-7)
3. Shut-down Phase: at least one of the last six chambers was operational (#2-7) until empty

This design of this continuous coater means there is no waste of any tablets during the start-up or shut-down phase, which may be encountered during continuous coating.

Tablet Testing

On completion of coating with Nutrafinish, color uniformity of the tablets was measured using a Datacolor spectrophotometric instrument (Diano Color Products Milton Roy Colormate). ΔE values were used to establish color uniformity (Cunningham & Neely, 2009). ΔE values lower than 2 are visually non-detectable. Gloss of tablets was measured using a model 801A gloss analysis system (Tricor Systems, Inc, USA).

Results

Final coated tablets, sampled following application of the Nutrapure coating in chambers #6-7, were smooth, uniform in color and free of visual defects (Figure 2a). Table 3 shows ΔE values lower than 1, suggesting the uniform distribution of color on these tablets. Application of Nutrapure also resulted in increased gloss value from 77 to 167 gloss units (Figure 2b). No difference in tablet properties during Nutrafinish coating (ΔE and gloss) and Nutrapure (gloss) was found between the start-up, continuous and shut-down phases (Table 2).

Figures 2a & 2b. Images of Tablets after a) Nutrafinish TiO2 Free Coating and b) Nutrapure Coating

2a) 3% WG Nutrafinish TiO2 Free Coating

2b) 3% WG Nutrafinish TiO2 Free Coating + 0.6% Nutrapure Coating

Table 2. Tablet Properties after Nutrafinish TiO2 Free Coating and Nutrapure Coating

Process	Nutrafinish Coating		Nutrapure Coating
	ΔE	Gloss	Gloss
Start-up	0.54	77	167
Continuous	0.33	83	166
Shut down	0.34	77	164

Conclusions

Nutrafinish TiO2 Free and Nutrapure Certified Organic coating, which provides high gloss, were successfully applied to multivitamin tablets in a single continuous coating process with high throughput in a DRIACONTI-T coating machine. No differences in the appearance of multivitamins were found during the start-up, continuous and shut-down phase of the continuous coater. Final tablets showed a consistent, high gloss and defect-free finish.

References

1. Cunningham, C. et al. Film Coating Process Considerations for the Application of High Productivity, High Solids Concentration Film Coating Formulations. AAPS, 2009.
2. Cunningham, C. et al. Simultaneous Application of a Two-part Delayed Release Coating in a Single Pass Continuous Coating Process. CRS, 2018.

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