THE IMPORTANCE OF USING COMPLEMENTARY PROCESS ANALYZERS FOR THE PROCESS MONITORING, ANALYSIS AND UNDERSTANDING OF FREEZE DRYING

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SUPPORTING INFORMATION

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Supporting Information Figures: 6 (figure S-1 to figure S-4)

Figure S-1. The product temperature plateau due to mannitol crystallization during the freezing step can be better monitored using the wireless temperature sensors when higher concentrations are freeze dried.

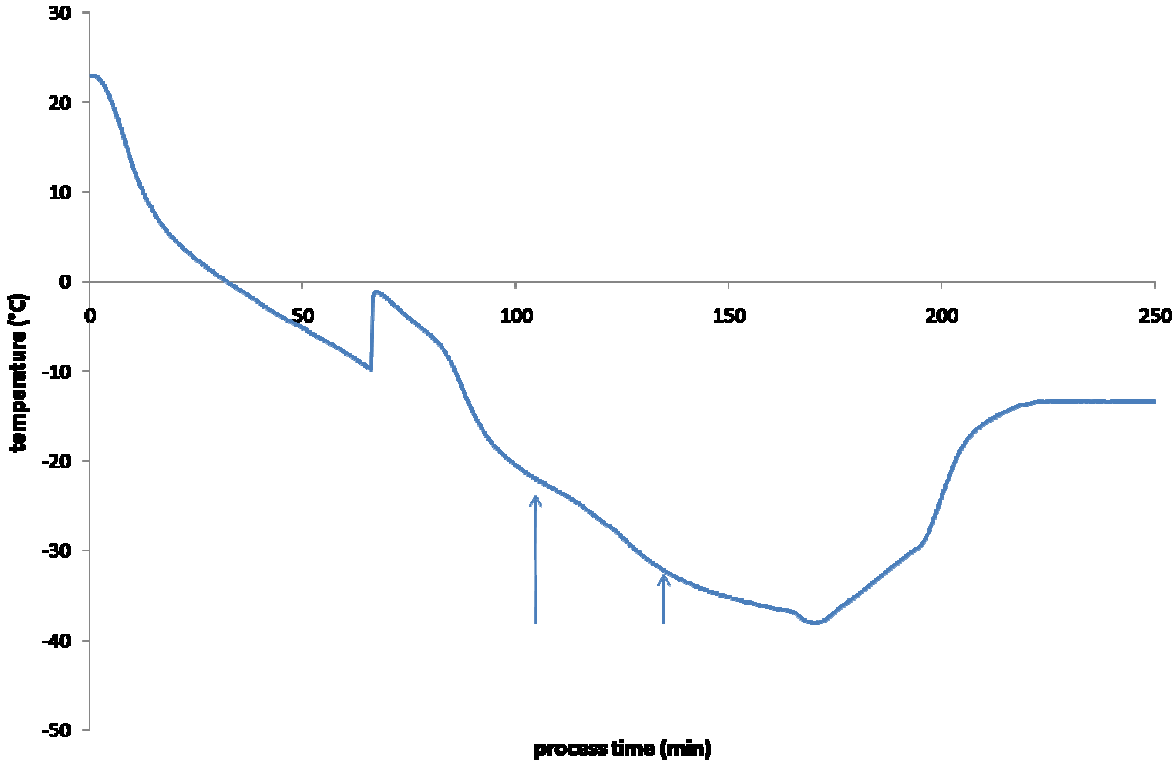

Figure S-2. Peak intensity of Raman ice band (215 cm^{-1}) versus process time during experiment 1.

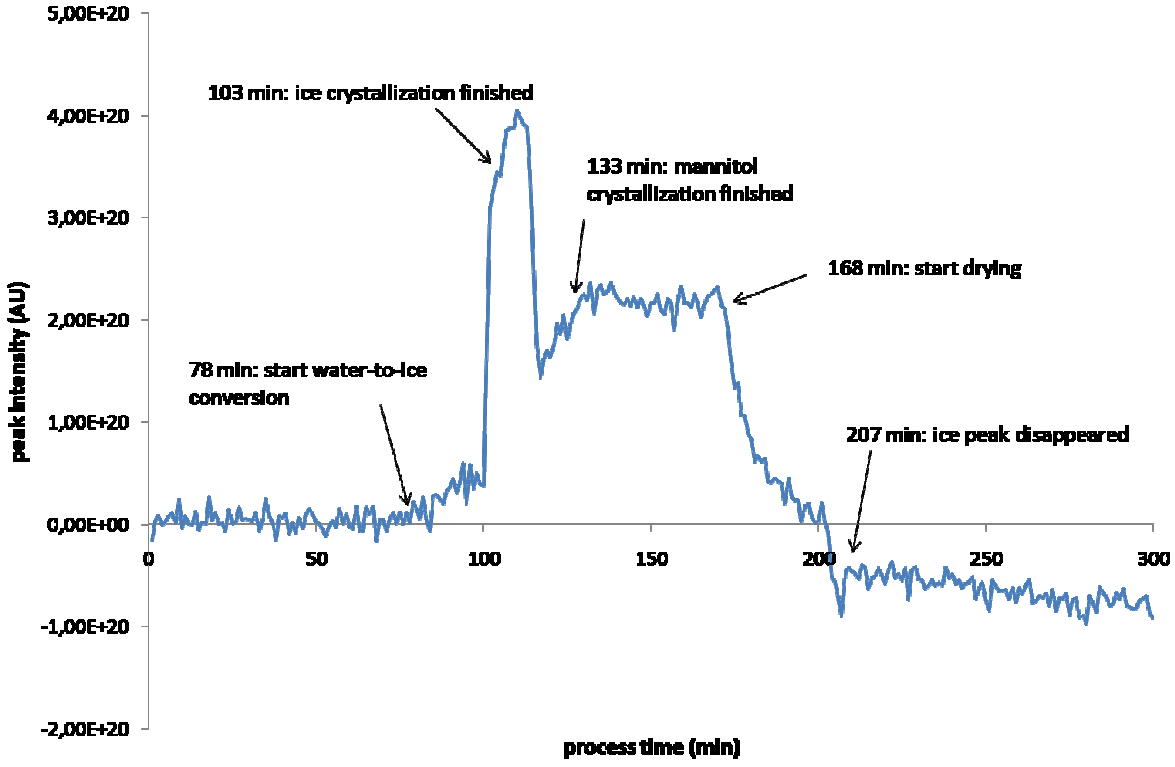

Figure S-3a. PCA result for the NIR data (4466-7243 cm^{-1}) obtained during the freezing step: scores for PC 1 versus process time plot. PC 1 capture 98.17 % of total spectral variance.

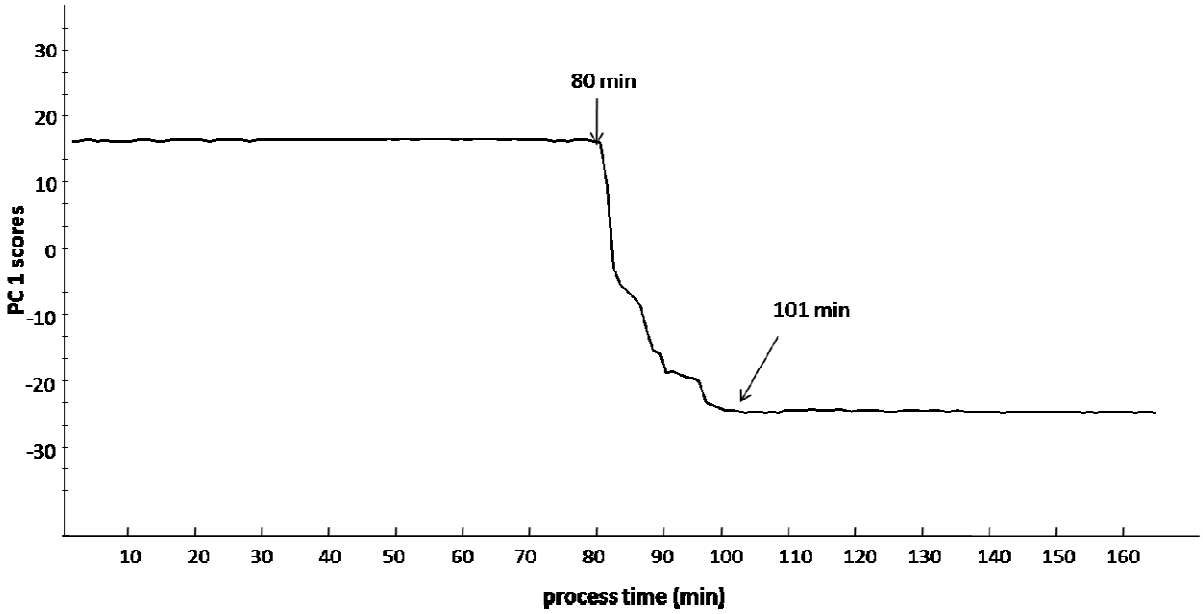

Figure S-3b. Difference between NIR spectra containing ice without crystalline mannitol (spectra collected before 136 min) and NIR spectra containing ice and crystalline mannitol (spectra collected after 136 min).

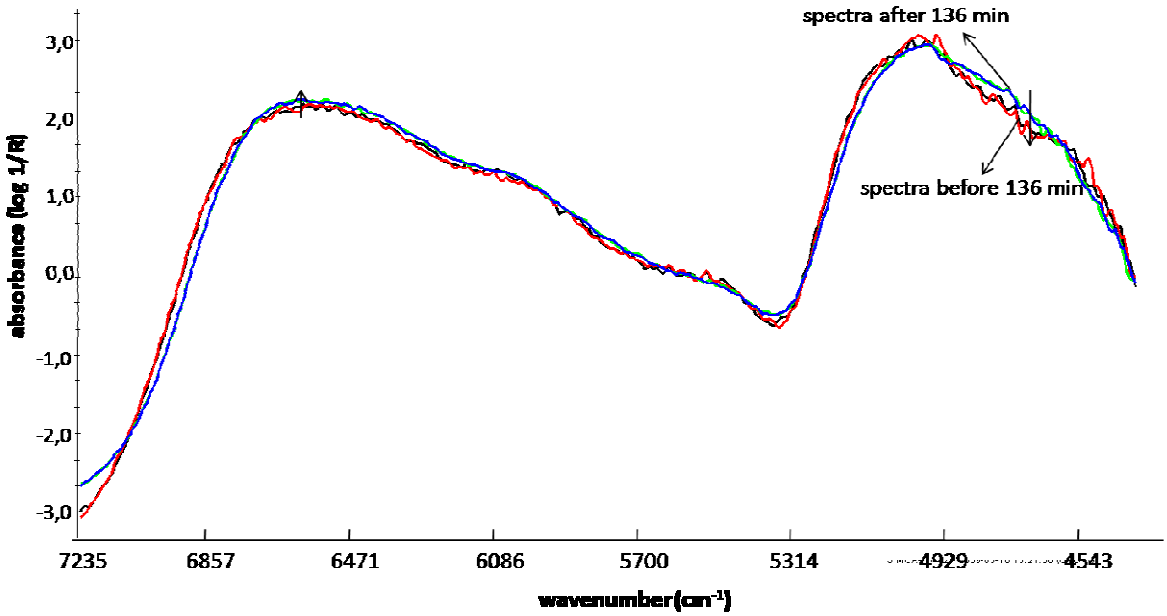

Figure S-4a. Raman spectral changes during secondary drying (1800 – 2300 min, experiment 3): transformation from mannitol hemi-hydrate to α-mannitol.

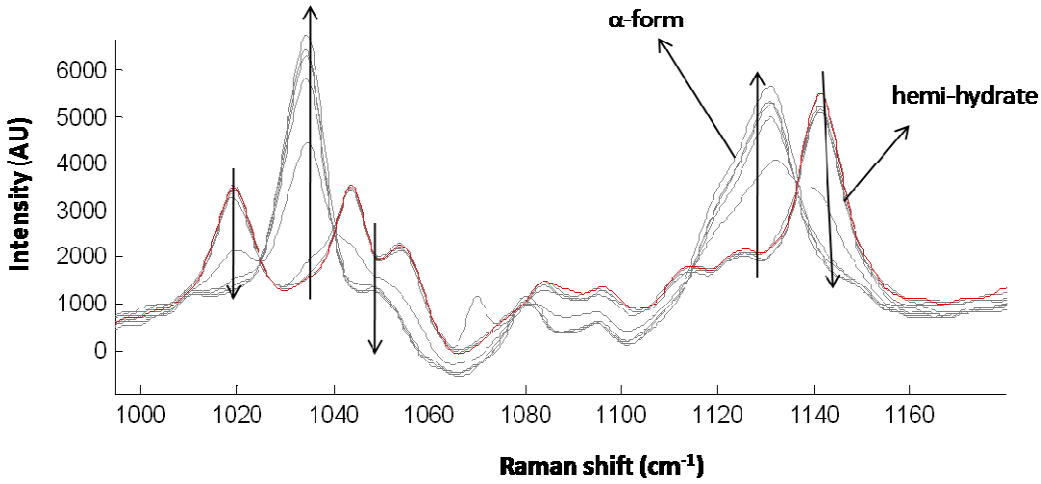

Figure S-4b. NIR spectra (second derivatives) collected during secondary drying of experiment 3 (5319 – 5050 cm^{-1}).