Effect of the degree of polymerization of maltodextrins on the moisture sorption isotherms and the phase transitions

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Sorption isotherms show material's dependence of water activities on equilibrium moisture content at specified temperatures and pressures. Various factors such as nature of adsorbate and adsorbent, molecular weight, and composition might influence the behavior of isotherms. Model systems, like maltodextrins (MD), can be used to identify these factors and define properties for similar food structures like phase transition changes. These transitions can be identified when running isotherms, indicating modifications of material's structure and this can be analyzed through mathematical models.

This research aims to evaluate conventional (GAB, Peleg, BET, Oswin, Khün) as well as non-conventional models (Statistical Physics models) to describe water adsorption and desorption isotherms of MD with different degrees of polymerization, identifying phase transitions to characterize the modifications of MD's properties.

Commercial MD with different dextrose equivalents (DE) (1, 5, 10, 15, and 20) were used. Sorption isotherms were determined with a Vapor Sorption Analyzer (Aqualab) using the Dynamic Dewpoint method. Conventional models were tested to fit experimental data of the MD at 25°C. Phase transitions were identified using the second derivative method (SDM) and verified observing physical changes (color, volume contractions, agglomerations) in the samples stored at different levels of relative humidity (RH: 24, 33, 40, 57, 62, 70, and 80%) generated in sealed containers with NaOH solutions. Additionally, glass transition was analyzed using a differential thermal analyzer device (DTA).

GAB and Peleg models described the behavior in adsorption and desorption isotherms with R2 of 0.992 and 0.986. Monolayer moisture content (MMC) in GAB model decreased as DE increased (%d.b. MMC: DE1-6.52, DE5-5.45, DE10-4.9, DE15-4.67 and DE20-4.45). SDM showed several phase transitions between aw of 0.3 and 0.8. These transitions were corroborated with the DTA and physical changes on the samples stored at different RH. SDM results showed that samples with less degree of polymerization had transitions identified as maximum peaks between aw of 0.3 and 0.6, while MD with DE of 10,15, and 20 indicated transitions in aw ranging between 0.6 and 0.7.

This study elucidates the effect of MD type and content of sorption isotherms as well as transitions phases involved during the process.