

Overcoming Obstacles in UHT High-protein Whey Beverages by Microparticulation Process: Scientific and Technological Aspects

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Abstract : Herein, a shelf stable (no refrigeration required) UHT processed, aseptically packaged whey protein drink was formulated by using a new strategy in microparticulate process. Applying thermal and two-dimensional mechanical treatments simultaneously, a modified protein (MWPC-80) was produced. Then the physical, thermal and thermodynamic properties of MWPC-80 were assessed using particle size analysis, dynamic temperature sweep (DTS), and differential scanning calorimetric (DSC) tests. Finally, using MWPC-80, a new RTD beverage was formulated, and shelf stability was assessed for three months at ambient temperature (25 °C). Non-isothermal dynamic temperature sweep was performed, and the results were analyzed by a combination of classic rate equation, Arrhenius equation, and time-temperature relationship. Generally, results showed that temperature dependency of the modified sample was significantly (P value<0.05) less than the control one contained WPC-80. The changes in elastic modulus of the MWPC did not show any critical point at all the processed stages, whereas, the control sample showed two critical points during heating (82.5 °C) and cooling (71.10 °C) stages. Thermal properties of samples (WPC-80 & MWPC-80) were assessed using DSC with 4 °C /min heating speed at 20-90 °C heating range. Results did not show any thermal peak in MWPC DSC curve, which suggested high thermal resistance. On the other hands, WPC-80 sample showed a significant thermal peak with thermodynamic properties of ΔG :942.52 KJ/mol ΔH :857.04 KJ/mole and ΔS :-1.22KJ/mole $^{\circ}$ K. Dynamic light scattering was performed and results showed 0.7 μ m and 15 nm average particle size for MWPC-80 and WPC-80 samples, respectively. Moreover, particle size distribution of MWPC-80 and WPC-80 were Gaussian-Lutresian and normal, respectively. After verification of microparticulation process by DTS, PSD and DSC analyses, a 10% whey protein beverage (10% w/w/ MWPC-80, 0.6% w/w vanilla flavoring agent, 0.1% masking flavor, 0.05% stevia natural sweetener and 0.25% citrate buffer) was formulated and UHT treatment was performed at 137 °C and 4 s. Shelf life study did not show any jellification or precipitation of MWPC-80 contained beverage during three months storage at ambient temperature, whereas, WPC-80 contained beverage showed significant precipitation and jellification after thermal processing, even at 3% w/w concentration. Consumer knowledge on nutritional advantages of whey protein increased the request for using this protein in different food systems especially RTD beverages. These results could make a huge difference in this industry.

Keywords : high protein whey beverage, microparticulation, two-dimensional mechanical treatments, thermodynamic properties

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