A Study on Morphological, Chemical and Physical Properties between Dark and Milk Chocolate as Influenced by Particle Size Distribution, Fat Content and Crystal Structure

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Cocoa butter is the main ingredient in chocolate manufacturing, which is responsible for the continuous flow, glossiness, texture and melting properties of the final product. Chemical properties of cocoa butter depend on the triglyceride composition and physical properties depend on the polymorphic form. The aim of the present study was to study the relationship between morphological (Scanning Electron Microscopy-SEM), chemical (Fourier Transform Infrared Spectroscopy-FTIR) and thermal properties (Differential Scanning Calorimetry-DSC) as influenced by particle size distribution (particle size analysis technique), total fat content (Soxhlet method) and crystal structure (powder X-ray Diffraction-XRD) of market samples (n=8) of dark and milk chocolate.

The results revealed that the crystallinity of dark chocolate was higher than that of milk chocolate. The chocolate samples contained stable cocoa butter polymorphic forms β (V) and β (VI). In all tested samples, the particles were not homogeneous as revealed by the respective test. The melting point of dark chocolate was positively correlated with the total fat content (r=0.75) and negatively (moderate) correlated with average particle size as revealed by SEM. The melting point of milk chocolate was negatively correlated with total fat content (r=-0.42), but it was negatively (moderate) correlated with SEM average particle size. In dark chocolate, the melting point was highly dependent on the cocoa butter content and polymorphic form of cocoa butter (r=-1.00).

The melting point of milk chocolate was found to be affected by the particle size and total fat content. Particle size distribution, crystal structure of cocoa butter and total fat content had a strong influence on the hardness of the chocolate samples. The hardness of dark chocolate was positively (weak) correlated with total fat content and negatively correlated (moderate) with SEM average particle size. Therefore, the cocoa butter fat content is an important criterion to produce harder dark chocolate. The hardness of milk chocolate was negatively (weak) correlated with the total fat content and the SEM average particle size. The milk fat content also had a positive effect on the hardness of the milk chocolate. Both dark and milk chocolates showed a positive relationship between crystal structure and hardness of the cocoa butter.

Keywords: Chocolate, Fat, Melting properties, Particle size distribution, Texture