Application Note B-TA1017

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TA1017 - Thermal analysis of pure cocoa by DSC

Introduction

Cocoa is manufactured from cacao beans and it is a complex material because its stability and crystallinity largely depend on the cooling process and storage conditions from the melt. DSC (Differential scanning calorimetry) plays an important role in characterizing cocoa. Here, we demonstrate the significance of DSC on evaluating the melting behavior of cocoa butter as affected by cooling rate and storage time.

Measurements and results

A 5 mg fresh pure cocoa powder was prepared in crimped Al pan. Heating and cooling cycles were measured using DSC from 0℃ up to 50℃. Heating rates were set at 5℃/min while cooling rates were performed in the order of 5℃/min, 2℃/min and 1℃/min. After cooling at 1℃/min, the measured sample in crimped Al pan was stored in room temperature (20℃ 52%RH) for 12 days prior to heating.

Figure 1 shows the DSC curve of the 5 mg pure cocoa powder at fresh (original) condition, cooled at 5℃/min, 2℃/min, 1℃/min and stored for 12 days with the numerical information shown in the table below. Result reveals that the melting of the original cocoa powder was observed from 31℃ with an enthalpy of 81 J/g. As the cooling rate decreases, the pure cocoa powder exhibits increasing of peak top temperature with an increase in enthalpy ratio. Moreover, storing the melted sample after cooling at 1℃/min further increased the enthalpy energy to 77 J/g which is 95% of the original enthalpy value. The peak top temperature also shifted to 33℃ which is 3℃ lower compared to the original condition. With this data, we can conclude that the gradual formation of the crystalline structure in cocoa butter is largely affected by cooling as well as storage time.

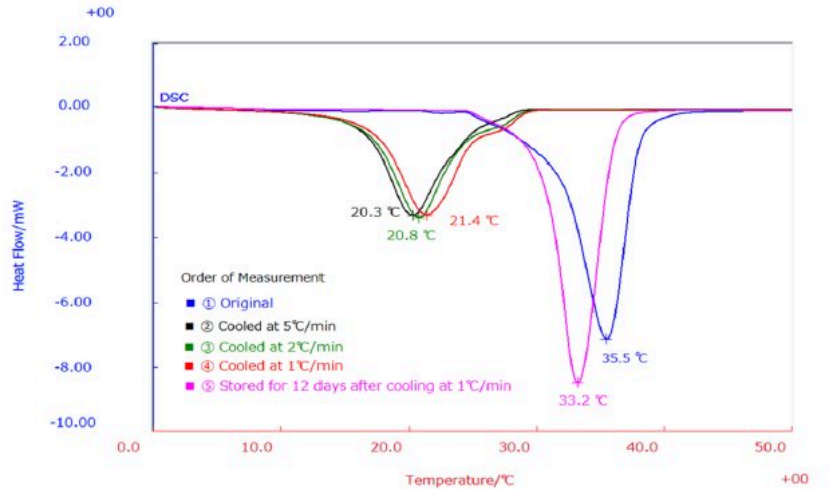

Figure 1: Melting behavior of pure cocoa powder as affected by cooling rate and storage time.

Table 1: Melting temperatures and enthalpy of pure cocoa powder.

Order of measurement	Onset temp (°C)	Peak top temp (°C)	Enthalpy (J/g)	Enthalpy ratio (%)
① Original	31.0	35.5	80.81	100
② Cooled at 5°C/min	16.4	20.3	45.72	56.58
③ Cooled at 2°C/min	16.7	20.8	46.63	57.70
④ Cooled at 1°C/min	17.1	21.4	47.21	58.42
⑤ Stored for 12 days after cooling at 1°C/min	30.2	33.2	77.41	95.79

Samples were kindly provided by Cacao Plantation Project, Negros Oriental, Philippines

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DSC is a thermal analysis technique that quantifies the amo unt of energy in a reaction.