Effect of Hydrostatic Pressure on Crystal Polymorph of Cocoa Butter

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For chocolate, it is important to have a good mouthfeel and snap when breaking it. The texture of chocolate greatly depends on the physical properties of cocoa butter (CB), the major ingredient of chocolate. There are six crystal polymorphs in CB. Among them, form V has a melting point of around 33°C, which makes ideal mouthfeel. And its density and stability are optimal for ease of piece separation from the mold and good snapping properties when breaking. Therefore, the control of form V is important.

In general, tempering is a temperature conditioning operation due to crystallizes CB in a form V. However, the length of the processing time and the high energy consumption associated with it can be a challenge. Therefore, we propose the application of hydrostatic pressure as a new external factor for more efficient form V crystallization instead of tempering. The application of pressure generally has the effect of changing the phase equilibrium of a material and improving the quality of crystals. Thus, it is also expected to be applied to crystal stabilization control technology. The aim of this study is to evaluate the effect of hydrostatic pressure on the crystal polymorph of CB.

Melted CB at 95°C was cooled down to 15°C at 20°C/min to crystallize into form II. Then hydrostatic pressure of 60 MPa was applied to the sample for 10 minutes by using a high-pressure hand pump (HP-100-2.5-PC, SYN Co. Ltd., Yokohama, Japan). Hydrostatic pressure applied samples were stored in an incubator at 20°C for 48 hours. Afterwards, their melting behavior and crystal polymorph were observed by differential scanning calorimetry (DSC, Hitachi Co. Ltd., Tokyo, Japan.) and X-ray diffraction measurement (XRD, Rigaku Co., Ltd., Tokyo, Japan), respectively.

In the DSC measurement, the sample with an application of a hydrostatic pressure of 60 MPa showed a larger melting peak near the melting point of form V, compared with that without 60MPa. In the XRD measurement, the sample without an applied hydrostatic pressure showed no diffraction profile of form V. On the other hand, the sample with an application of a hydrostatic pressure showed diffraction profile of form V. Therefore, it was found that the application of a hydrostatic pressure promotes the transformation to form V for CB.