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Structure-fracture relationships in chocolate systems

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## 1 **Structure-fracture relationships in chocolate systems**

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### 5 6 **Abstract**

7 The fracture properties of model and real chocolates were investigated using a three-point  
8 bend test. Chocolate bars were stored under cycling temperatures between 20 °C and 29 °C  
9 for 60 d, during which V-to-VI polymorphic transformation of cocoa butter was examined by  
10 X-ray diffraction. Prior to storage, the Young's modulus and fracture stress of both model  
11 and real chocolate bars increased with a reduction in fat ratio, owing to decreasing particle-  
12 particle or particle-fat interactions. In addition, the model chocolate bars with larger particle  
13 size had lower Young's modulus and fracture stress due to the lower free fat ratio and higher  
14 void ratio of the matrix. After storage, the Young's modulus of bloomed chocolate bars  
15 increased due to the decrease in liquid fat ratio, while the fracture stress decreased as a result  
16 of the growth in void space as fat bloom developed. However, no significant ( $P < 0.05$ )  
17 interactions between storage time and fat ratio or particle size were found.

18 **Keywords:** Young's modulus; fracture stress; chocolate texture; fat bloom

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