Cooling Rate Effects on Solid Fat Content Determination

Sir:

There are two types of standard methods developed by the AOCS and the IUPAC for the determination of solid fat content (SFC). The first method is for nontempering fats (AOCS Cd 16-93/IUPAC 6.2.2.1), and the second method is for tempering fats (AOCS Cd 16-81) such as cocoa butter. The tempering method is typically used in situations where the fats are known to crystallize into a wide variety of polymorphic forms. Tempering the fat induces the formation of the most stable polymorphic form in fat crystals.

A study was conducted in our laboratory to investigate the effects of cooling rate on the final SFC of anhydrous milk fat (AMF), cocoa butter, and vegetable shortening using standard and controlled rate methods. Controlled cooling rates of 0.1, 0.3 (AMF only), and 1°C/min, as well as a fast quench/plunge were used to crystallize these fats prior to SFC determination. An outline of the methodology used in this study is shown in Figure 1.

Figure 2A compares the SFC vs. temperature melting curves for AMF crystallized at different cooling rates with ones obtained using the nontempering (AOCS Cd 16-93) method. In the range of 0–20°C, AMF showed SFC differences as high as 10% (at 0°C) between the fastest (AOCS Cd-16-93) and slowest (0.1°C/min) cooling rates. It is interesting that the samples cooled at 1°C/min had an SFC that was on average 1% higher (from 0–15°C) than the value obtained using the standard nontempering method. Beyond 20°C, there were no differences in SFC among the methods used.

Figure 2B compares results obtained using the tempering (AOCS Cd 16-81) and nontempering (AOCS Cd 16-93/IUPAC 6.2.2.1) methods. At 0ºC, SFC values were similar. However, from 5 to 22°C the tempering method yielded SFC values that were 1–5% lower than the nontempering method. Beyond 22°C there were no significant differences in SFC.

Figure 2C compares the cooling rate methods with the AOCS standard methods for SFC determination in cocoa butter. No differences in SFC were observed in the ranges of

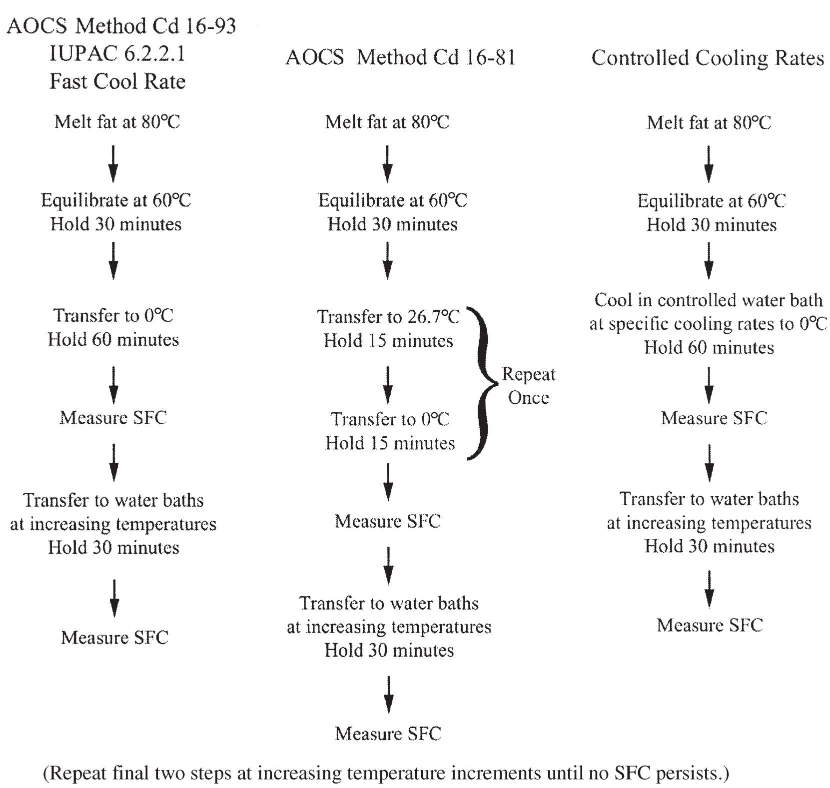

FIG. 1. Standard and controlled cooling rate methods for solid fat content (SFC) determination.

Paper no. J10482 in *JAOCS 80*, 835–836 (August 2003)

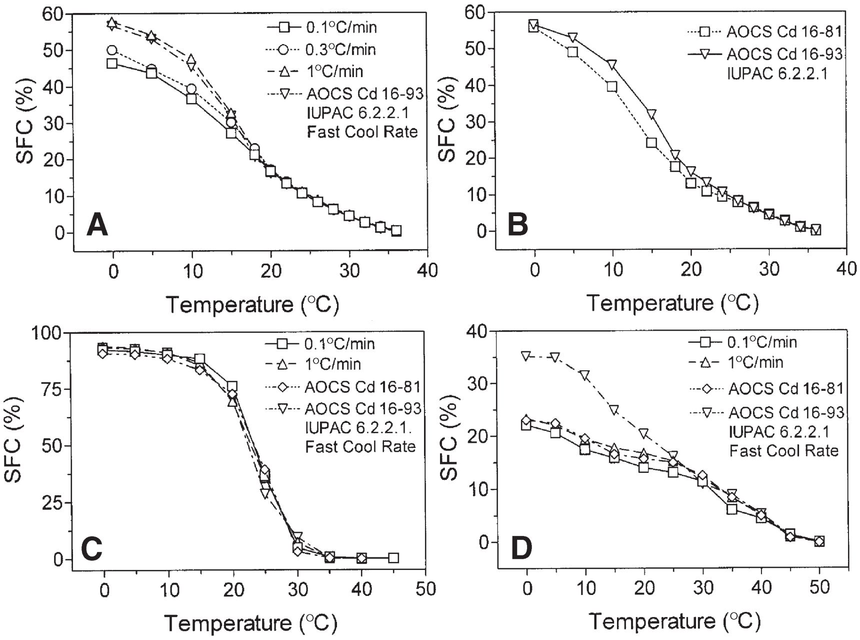

FIG. 2 Comparison of SFC determined using controlled cooling rates and the AOCS standard methods Cd 16-93 and Cd 16-81. (A) AMF cooling rates and AOCS Cd 16-93; (B) AMF comparison of tempering and nontempering AOCS standard methods; (C) cocoa butter at all cooling rates and standard methods; and (D) vegetable shortening at all cooling rates and standard methods. Symbols represent the average and SE of six replicates; where error bars are not visible, the error is smaller than the symbol. AMF, anhydrous milk fat; see Figures 1 for abbreviation.

0–10°C and 30–40°C under any of the processing conditions used, whereas minor differences were detected between 15 and 30°C.

Figure 2D shows the effects of controlled cooling rate methods and AOCS standard methods on the SFC of vegetable shortening. There were minimal differences in SFC between the controlled cooling rate and tempering methods over the entire temperature range studied. The SFC of the vegetable shortening prepared using the nontempering method, however, was 2–12% higher than the SFC of samples prepared using the other methods in the temperature range of 0–20°C. Above 20°C, all treatments yielded SFC values that were not statistically different.

Our results indicate that cooling rate can dramatically influence SFC values. For this reason, we believe that cooling rate control should be explicitly specified in standard methodology.

Geoffrey G. Rye and Alejandro G. Marangoni*
Department of Food Science, University of Guelph,
Guelph, Ontario, N1G 2W1, Canada

*To whom correspondence should be addressed.
E-mail: amarango@uoguelph.ca