Does cannabidiol affect the physical properties of anhydrous milk fat and palm kernel oil?

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Methods

Concentrations of 0%, 1%, and 2.5% cannabidiol (CBD) by mass were dissolved in anhydrous milk fat (AMF) and palm kernel oil (PKO) to evaluate the effect of CBD on the crystallization behavior and physical properties of these fats. AMF was crystallized at 26° C for 90 min while measuring solid fat content (SFC). PKO was similarly crystallized at 22° C for 90 min. Solid fat content (SFC) was measured with a pulsed nuclear magnetic resonance analyzer (p-NMR). These data were then fitted to the Avrami Equation. After 90 min of crystallization physical properties were measured. Crystal size was measured with a polarized light microscope. The melting profile was measured with a differential scanning calorimeter (DSC). Hardness was measured with a texture profile analyzer (TPA). Elasticity was measured with a rheometer. A DSC was also used to measure the melting points of the samples. These properties were measured for each CBD concentration of each lipid. Elasticity and hardness measurements required an additional 48-hour crystallization period, as described in the relevant figures.

Results

- The solid fat content data (Figure 1) shows that the presence of CBD increases the crystallization time of both fats. CBD also causes them to reach a final SFC that is inversely related to CBD concentration. This effect is more prevalent in PKO than in AMF.

- SFC data was fitted to the Avrami equation (eq.1) which shows the slower crystallization rate (Table 1)

$$SFC(t) = SFC_{max}\left(1 - e^{-kt^n}\right) \qquad (eq.1)$$

- No significant difference was observed in the melting profiles (Figure 3), hardness (Figure 4), or melting point (Table 2) of either sample.

- For elasticity data, bars with the same letter are not significantly different (α = 0.05, Figure 5). These relations are specific to each lipid's data.

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Fig 1. Solid fat content of AMF and PKO as a function of time for 3 CBD concentrations

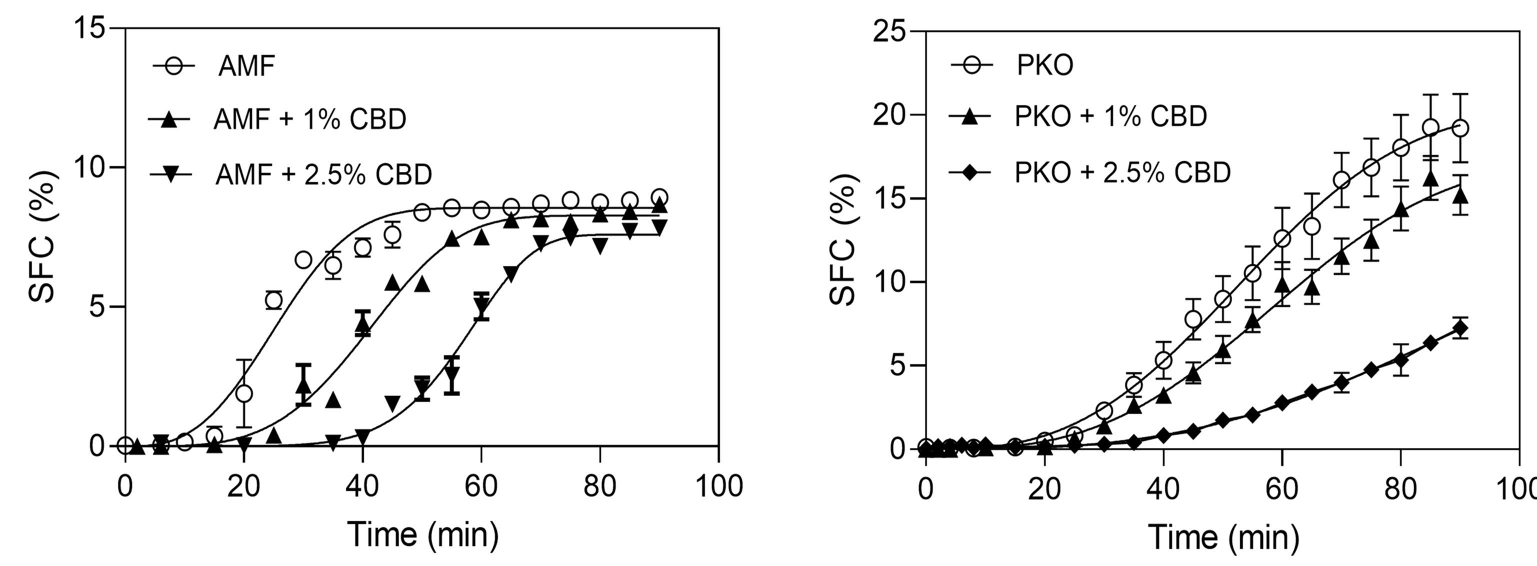

Table 1. Avrami equation parameters for AMF and PKO for 3 CBD concentrations

	AMF + 0% CBD	AMF + 1% CBD	AMF + 2.5% CBD	PKO + 0% CBD	PKO + 1% CBD	PKO + 2.5% CBD
SFC_{max}	8.56	8.28	7.6	20.37	17.35	14.38
k (min^{-1})	6.70 x 10^{-5}	3.89 x 10^{-7}	8.61 x 10^{-13}	7.81 x 10^{-6}	3.68 x 10^{-6}	9.64 x 10^{-7}
n	2.86	3.88	6.78	2.86	2.98	3.0
R^2	0.9685	0.9835	0.9854	0.9440	0.9610	0.9605

Fig 2. Polarized light microscopy of AMF and PKO for 3 CBD concentrations

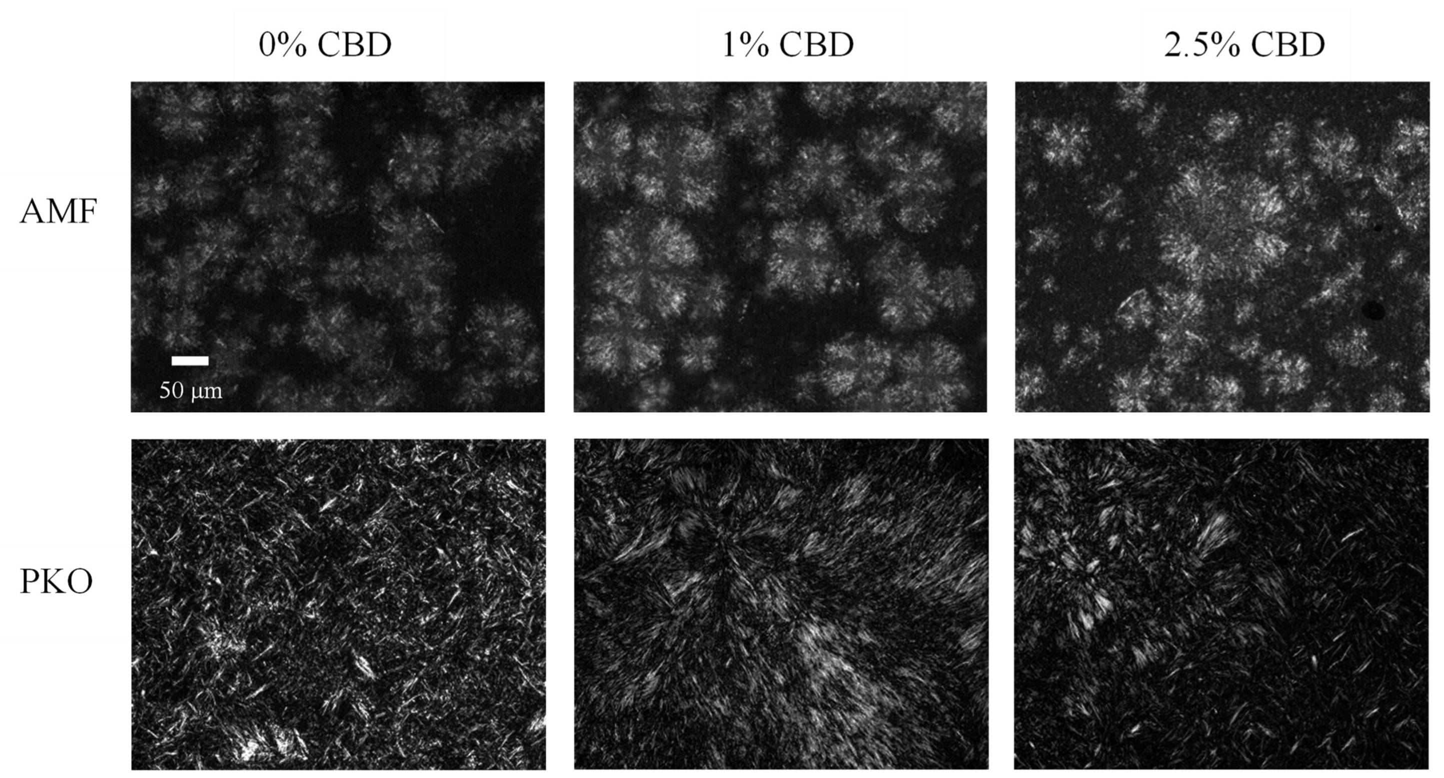

Fig 3. Heat flow of AMF and PKO as a function of temperature for 3 CBD concentrations

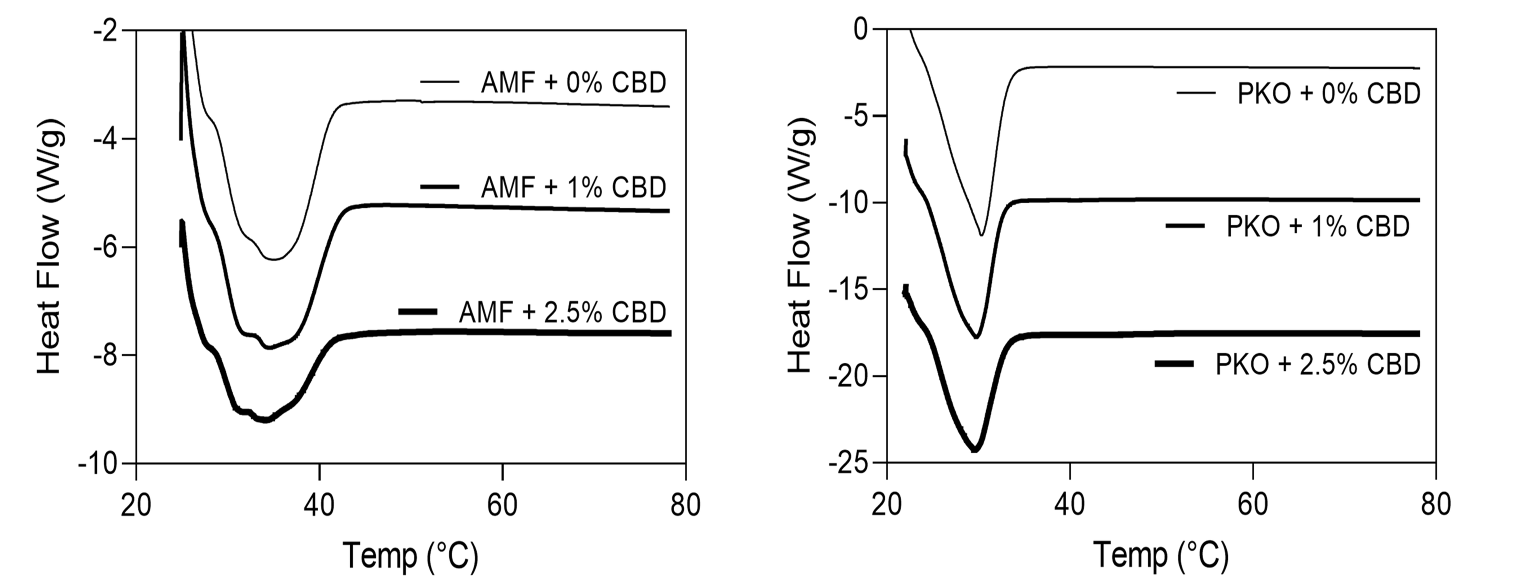

Fig 4. Hardness (N) of AMF and PKO crystallized at 5 °C for 48 h for 3 CBD concentrations

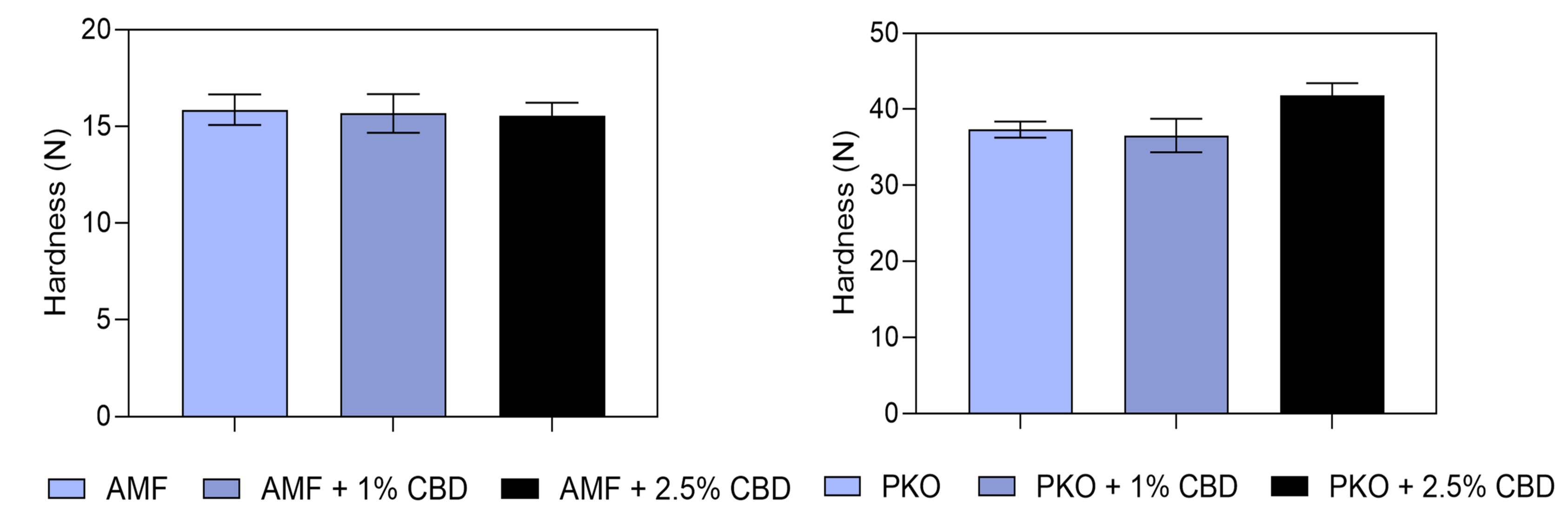

Fig 5. Elasticity (G') of AMF and PKO as a function of storage temperature for 3 CBD concentrations

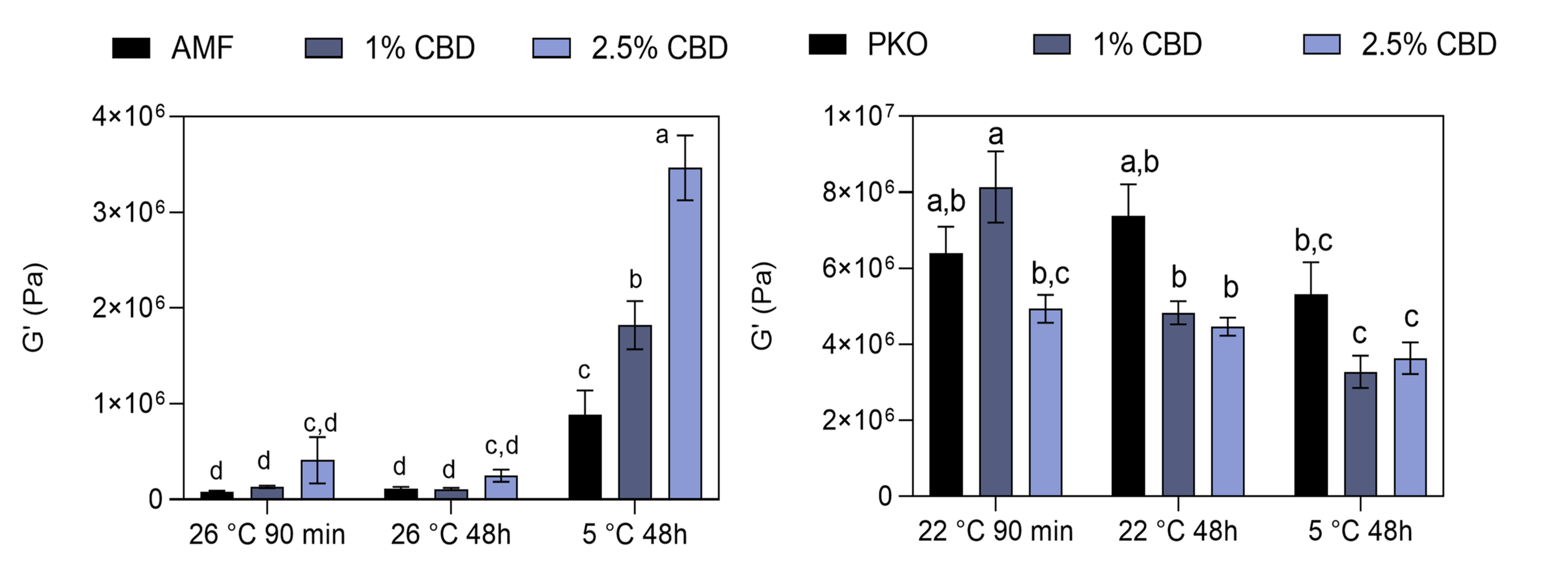

Table 2. Melting point of AMF and PKO for 3 CBD concentrations

	0% CBD	1% CBD	2.5% CBD
AMF	33.4 ± 0.6	33.4 ± 0.8	33.4 ± 0.6
PKO	27.7 ± 0.1	27.1 ± 0.1	27.1 ± 0.1

Conclusion

- CBD delays the crystallization of AMF and PKO and generates a more elastic AMF when stored at 5°C.
- CBD does not affect the hardness of AMF and PKO nor the elasticity of PKO.
- CBD does not affect the melting point nor the melting profile of AMF and PKO.
- CBD slightly increases crystal sizes of AMF and PKO.

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