Effect of additives on thermal, rheological and tribological properties of 3D printed dark chocolate

ABSTRACT

Food additives can be used to enhance processability and/or nutritional properties of food. In this study, two type of additives, magnesium stearate (Mg-ST) powder (as a processing aid) and plant sterol (PS) powder (as a processing and nutritional aids) were added into grated chocolate in order to enhance its flowability during auger type extrusion-based 3D printing. The thermal and rheology data showed that the melting peak of chocolate with additives ranged from 31.4 ± 0.8 °C to 32.1 ± 0.1 °C and a rapid reduction in viscosity began between 31.1 ± 0.7 °C and 33.3 ± 0.2 °C. The addition of additives showed no significant difference (p > .05) in melting peak (Tp) temperature of control chocolate samples and 3D printed chocolate samples suggesting that Mg-ST and PS do not affect the melting behaviour of chocolate. However, the yield stress values of chocolates containing additives were relatively higher than that of control samples indicating the possible effect of particulates. The tribology curve did not represent the typical Stribeck curve with or without the addition of additives. The particles in the additive potentially influenced the lubrication behaviour of 3D printed chocolate as their addition increased the coefficient of friction of the chocolate samples reducing the slippage in auger extrusion.