Evaluating 3D printing as a technology for producing dairy snacks based on temperature-controlled rennet induced gelation of protein-fortified milk.

3D food printing (3DFP) has the potential to develop products with complex structures, personalised nutrition, and customised textures. However, only foods with suitable physicochemical or rheological properties are suitable for 3DFP to ensure a self-supported structure is printed. Milk proteins can form structured objects (i.e., cheese, yoghurt), and so are potential ingredients for 3DFP. This study aims to adapt the rennet gelation from the curdling process of cheese-making to produce 3D printed dairy snacks using milk protein isolate-fortified milk. It is well known that curdling of milk by rennet is temperature dependant; therefore, the rennet gelation properties (G' and G'') were investigated using a temperature ramp (5 - 40°C) at a rate of 5°C min^{-1} after the addition of rennet (0.5 mL per 100 g of sample) at 4°C at different time intervals (0.5, 1, 1.5 and 2 hrs) using a controlled strain/stress rheometer (strain = 1 % and frequency = 1 Hz). Based on rennet gelation measurements, a custom-designed syringe-based 3D printer was used to evaluate the printer's temperature-controlled platform to control gelation to build a cylinder (r = 1 cm and h = 1 cm). The results showed that at 4°C, rennet addition to milk formed a soft gel (< 1×10^{-3} kPa), and when heated to 40°C, the strength increased (~4 kPa). Gelation could be triggered by the temperature-controlled platform, allowing it to form a self-supported structure. It is concluded that rennet gelation can be adapted to produce dairy snacks using a temperature-controlled device in a 3D printer.