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3D printing complex chocolate objects: Platform design, optimization and evaluation

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1 3D Printing Complex Chocolate Objects: 2 Platform Design, Optimization and 3 Evaluation.

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11 **Abstract**

12 3D printing of foods is an emerging technology that makes it possible to produce unique and complex
13 food items. A number of different foods have already been 3D printed, however, better
14 characterisation of fabrication parameters is still necessary to improve quality and efficiency. In this
15 paper, we present details of the construction of a melt extrusion 3D printer based on readily available
16 open source components. Several key fabrication parameters were investigated and optimised to
17 enable printing complex 3D objects made from chocolate. The ability of an extruded chocolate fibre to
18 span large distances without collapsing was investigated by adjusting variables such as movement
19 speeds, extrusion rates and cooling rates. We found that the chocolate spanning distance was
20 unaffected by movement speeds ranging from 300 to 700 mm/min, and that the optimal extrusion rate
21 was 10–20% leaner. Furthermore, the spanning distance improved by directing air across the printing
22 part, lowering the air temperature by approximately 3.5°C. The results from this research can be
23 applied to 3D printing of complex objects using chocolate and other similar foods.

24 **Keywords**

25 Chocolate, 3D printing, digital gastronomy, additive manufacturing, open source

26 **1.0 Introduction**

27 Additive manufacturing and 3D printing technologies are driving the emerging field of food printing
28 with the promise of highly customisable foods for applications in high end markets, and for controlled
29 nutrition intake. This high level of customisation has garnered the interest of the confectionary
30 industry, to expand market-share with increasingly novel and commercially attractive products (3D

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