Use this page to provide an abstract (up to 350 words) outlining the research described in your poster. **This OUTLINE MUST BE APPROVED AND SIGNED BY THE DEPARTMENT HEAD OR MAJOR PROFESSOR.** (Note: *email notification by your advisor to Ms. Debbie Koch can be substituted for the signature)*

DIRECT FORMATION OF 3-D PRINTED FOOD STRUCTURES USING VISCOUS JET COILING INSTABILITY

3D food printing is a digitally-controlled process that constructs solid foodstuff with complex structures by depositing material layer by layer. It is a shaping process that can be used to design and produce food matrices on demand with controllable and programmable material distribution. However, this process can be time consuming due to the necessity of designing complicated toolpaths for the printhead to accommodate multiple complex shapes and structures.

The goal of this project is to utilize the mechanism of viscous coiling to generate a variety of patterns depending on the moving speed, height of deposition, flow rate and fluid properties. By utilizing this fundamental property of fluid material, self-organizing food structures can be fabricated eliminating complicated pathway design.

To accomplish this goal, we designed and constructed a custom 3D food printing system consisting of a printhead and a positioning system. We experimentally explored a set of operational parameters such as height of deposition, nozzle diameter, flow rate, and moving speed of the platform with food materials with different rheological properties. We demonstrated that 1D,2D and 3D structures of various geometry can be deposited in predictable way using just linear motion of the printhead.

Experiments were conducted using different food matrices including chocolate icing, soy flour dough, and whey protein solution. Various patterns were successfully produced including meanders, translated coils, alternating loops, and w patterns. Phase diagrams were constructed and phase boundaries were identified. The dimensionless speed mismatch between the printhead and the moving substrate was identified to be the critical operational parameter for producing different patterns. Using the constructed phase boundaries, we were able to build one dimensional, two dimensional and three dimensional food structures with various complicated patterns. Obtained results are in good correspondence with a mathematical model for liquid rope coiling.

This study confirms the potential of constructing on-demand controllable and programmable complex food structures with simple linear toolpaths. This is first time that viscous coiling was used to form structured food matrices, demonstrating a new approach for food 3D printing and food matrix physical design.

The above, proposed plan of research is approved and accepted.

DATE SIGNATURE OF DEPARTMENT HEAD OR MAJOR PROFESSOR - PRINT NAME