ASSESSING 3D PRINTABILITY AND GLYCEMIC INDICES OF MARZIPAN WITH DIFFERENT NATURAL SWEETENERS

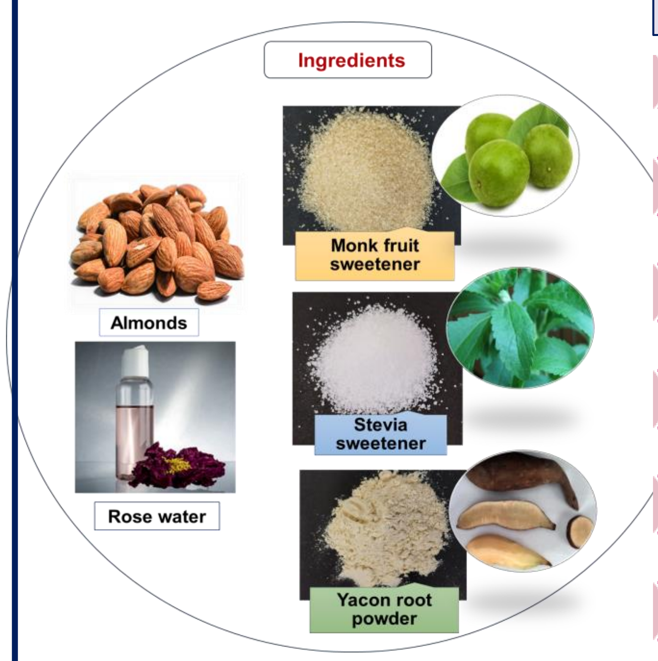
Neeta S. Ukkunda, Santhoshkumar P., J.A. Moses*

Computational Modeling and Nanoscale Processing Unit,
National Institute of Food Technology, Entrepreneurship and Management, Thanjavur (NIFTEM-T), Tamil Nadu, India
* moses.ja@iifpt.edu.in

Background

- Food 3D printing is the best option to make consumer-oriented, health-promoting, functional ingredients-rich snacks/confectionary with different customized shapes.
- Food 3D printing can be used to produce food with optimized proportions of fat, sugar, and salt based on the health status of consumers.
- Ready-to-use, ready-to-cook category products can be made available in a shorter time, enhancing production efficiency, and yielding higher throughput at industrial adoption.

Methodology



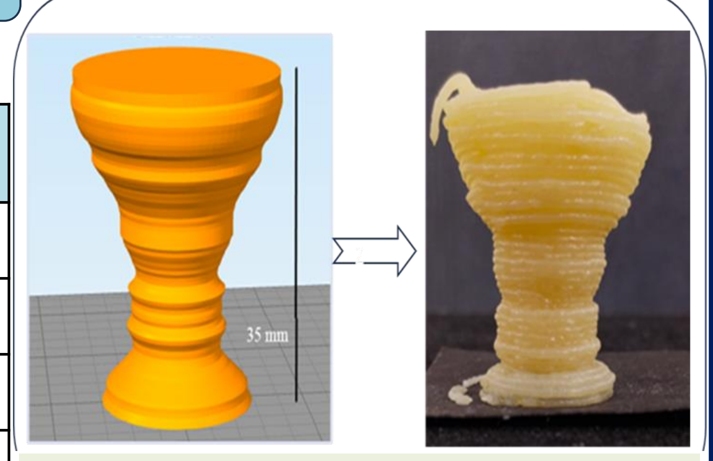
Material supply preparation steps

1. Soaking (sweet almonds) for 12 hours
2. Deskinning (manually)
3. Drying at 60 °C for 8 hours (Labtech hot air oven, LTMH05-6, India)
4. Ground for 30 s using a grinder (Vidiem Mixer Grinder 518 A VSTAR, India)
5. Almond flour/powder (Particle size range: 0.71-1 mm, Moisture: 4.26 ± 0.01 (%db)
6. Powder + Rose water (for fragrance) + Potable water + Sweeteners (Either of the sweeteners: stevia, monk fruit, yacon root powder, and table sugar)
7. Ground to obtain a paste

Marzipan composition evaluated with 4 natural sweeteners

Table sugar (TS), Stevia (SS), Monk fruit (MF), Yacon root powder (YR)

Material supplies	Almond (g)	Sugar (g)	Sweetener (g)	Water (mL)
TS	66.67	18.51	0	14.81
SS	73.46	-	10.2	16.326
MF	69.9	-	14.56	15.53
YR	66.67	9.259	9.259	14.81

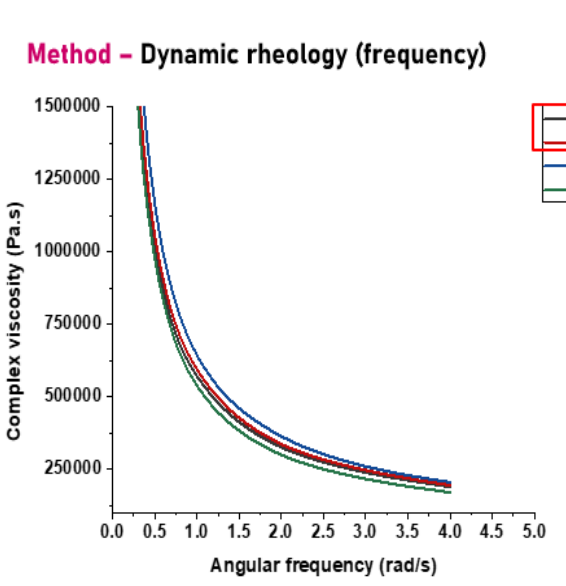


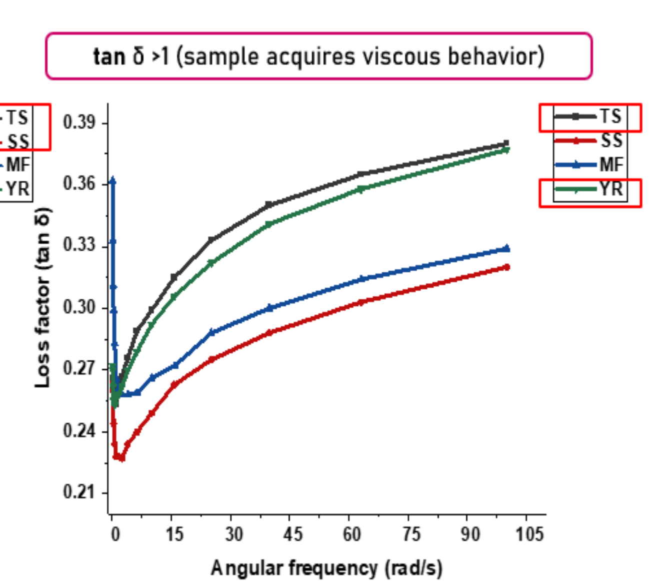
Technique: Extrusion 3D food printing

Printing conditions experimented were:

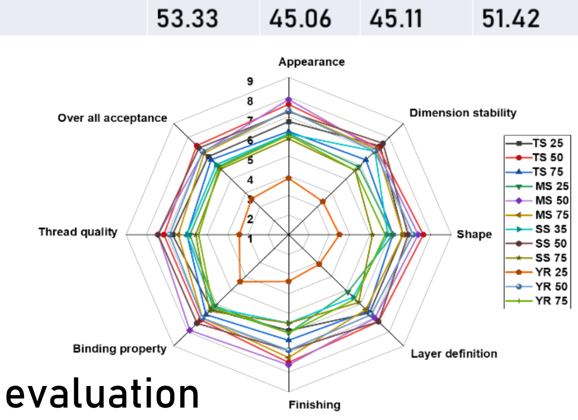
Parameter	Nozzle diameter	Infill	Pressure	Extrusion motor speed	Printing speed	Printing rate (g/min)
Value	0.84 mm 1.22 mm 1.80 mm	25 % 50 % 75 %	~3 bar	15 rpm	800 mm/min 1600 mm/ min 2400 mm/min	(weight of the printed sample)/(time taken for printing)

Results

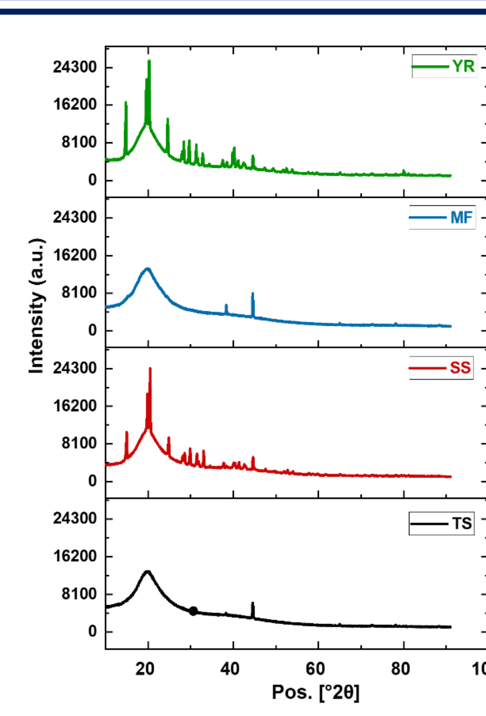




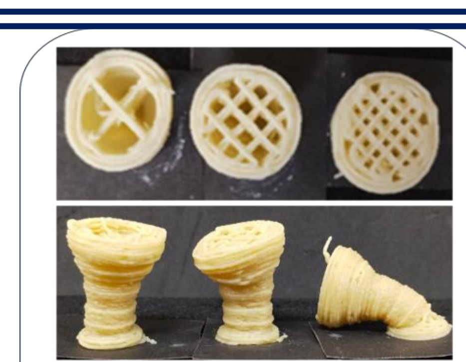
Parameter	TS	SS	MF	YR
Crystallinity	58.26	38.66	50.91	41.85
Consistency index ($Pa.s^n$)	2632.67	1680.00	2012.00	2319.00
Flow behavior index	0.367	0.426	0.538	0.396
Deformation %	84.75	87.16	87.68	84.75
Recovery %	70.49	65.87	63.25	63.35
GI value	53.33	45.06	45.11	51.42



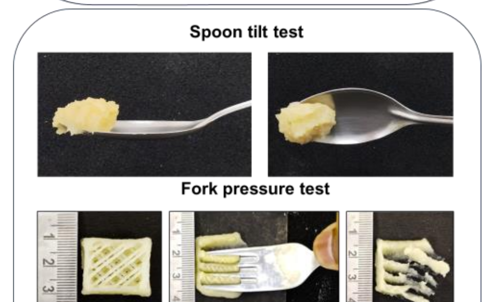
Sensory evaluation



X-ray diffractogram



Post-printing stability and quality



IDDSI Food description

Conclusion

- The optimal printing conditions for a 3D chalice model were 1.22 mm nozzle size, 3 bar compressed air pressure, 15 rpm motor speed, and 800 mm/min printing speed.
- Stability assessment of the printed constructs at varying infill densities (25, 50, and 75%) and time intervals (6, 12, 18, 36 h), alongside sensory evaluation, highlighted that the sugar formulation was the best, followed by monk fruit.
- This work's findings will be significant in studies involving the development of low-GI 3D-printed foods.

Reference

1. Kavimughil, M., Leena, M. M., Moses, J. A., & Anandharamakrishnan, C. (2022b). Effect of material composition and 3D printing temperature on hot-melt extrusion of ethyl cellulose-based medium chain triglyceride oleogel. Journal of Food Engineering, 329(March), 111055. https://doi.org/10.1016/j.jfoodeng.2022.111055
2. Santhi Rajkumar, P., Suriyamoorthy, P., Moses, J. A., & Anandharamakrishnan, C. (2020). Mass transfer approach to in-vitro glycemic index of different biscuit compositions. Journal of Food Process Engineering, 43(12), e13559. https://doi.org/10.1111/jfpe.13559