3D printing of banana incorporated pearl millet snack

MOSES J. (1), SANTHOSHKUMAR P. (1), VIJAYAKUMAR R. (1), PRIYADARSHINI S. (1)
1 NIFTEM-Thanjavur, Thanjavur, India

Objective:
3D printing is a promising method to create foods with specialised nutrients. This research investigated the potential of 3D printing for the creation of a snack product using pearl millet flour (PMF) with an alternative natively non-printable ingredient, ripe banana (RB).
Methods:
The material supply (dough) combinations with 52 and 55% w.b. moisture content (100:0, 80:20, 60:40, 40:60, 20:80, 0:100 PMF: RB) were analysed for the physical, mechanical and physiochemical parameters. Printability studies were conducted to optimize the printing speed (600, 800, 1000 mm/min), motor speed (120, 180, 240 rpm) and nozzle diameter (1.22, 1.56 mm) at constant pressure (up to 3 bar). Optimised 3D printed constructs were evaluated by sensory panellists based on their binding property, layer definition, etc. The printed constructs are post- processed by steaming (10 min) and microwave cooking (540 W; 3 min) and the sensory analysis was conducted to evaluate the consumer preference.
Results:
All the material supply combinations were observed to be shear thinning (n=0.16-0.67). The total colour difference E values were ranged from 1.56 to 17.46 during banana incorporation. Water activity and bulk density of material marginally reduced with increase in quantity of banana. Values for gumminess, chewiness, cohesiveness, and springiness are increased when hardness is reduced during the banana incorporation. Three combinations (100:0, 80:20, 60:40 PMF: RB) are printed with high layer definition and precision. In addition, incorporation of banana resulted in an increase in fats (1.23-4.68 g/100g), ash (0.78-0.95 g/100g) and a decrease in protein (4.2-3.7 g/100g) content. Based on the sensory score, the optimized condition for printing the constructs is as follows; 600 mm/min printing speed; 240 rpm motor speed; 1.22 mm nozzle. Sensory attributes were more favourable to microwave-cooked snacks.
Conclusions:
This study gives the fundamental understanding of the role of 3D printing in producing millets-based snacks. It would be the foundation for 3D printing technology with an emphasis on development of highly nutritious foods with improved consumer acceptance.