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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
onfoods

Study of Edible food inks from vegetable by-products

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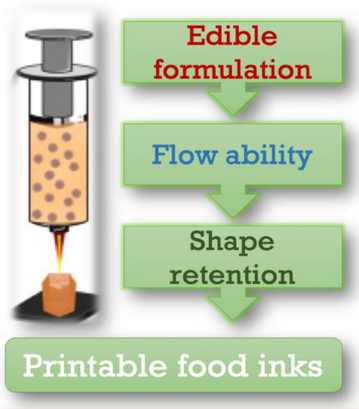

Introduction

In recent years, numerous research and development studies have been carried out on 3D food printing to create foods with geometric complexity, enabling shape customization with economic and environmental benefits. The **rheological** characteristics of food inks are of critical importance. These materials must match two special characteristics: to be fluid enough when subjected to flow so that they can be deposited on printing platforms, but simultaneously to be consistent enough to retain their **shape** once deposited (1). Edible inks are composed of **biopolymers** such as polysaccharides or proteins and fats (2). On the other hand, the possibility of reusing **vegetable pieces** is interesting from the perspective of **circular economy and sustainability**. Their possible reuse is perfect for **3D printing inks**!

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Vegetable waste (*Broccoli, Pumpkins, Carrots, Zucchini*) → **Rheological optimizzation** → **Printable edible ink**

Sample preparation:

1. **Defrosting**
2. **Mixing, 25°C - 5 min**
3. **Ingredients addition**
4. **Stirring at 80°C, - 20min, Kenwood cooking chef XL**
5. **Homogenization, 2 min Multishake Imetec**

Samples			
Component	**ZB**	**ZP**	**ZH**
Vegetable puree	67	67	67
Citrus Fiber	3	3	3
Potato Starch	15	15	15
Pea Protein	0	10	0
Hemp Protein	0	0	16
Brown Rice Protein	10	0	0
Sunflower Oil	5	5	5
Salt	0.3	0.3	0.3

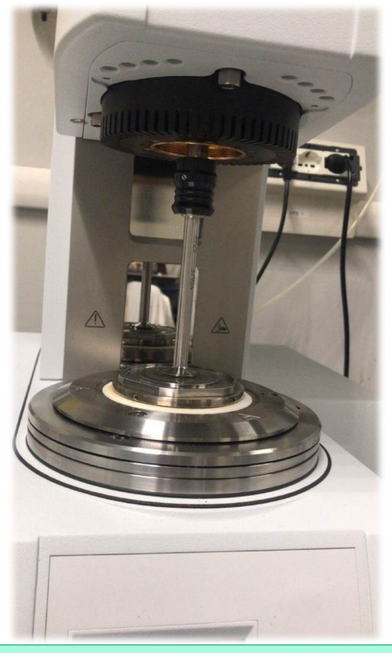
Rheological Characterization

MCR702e, Anton Paar

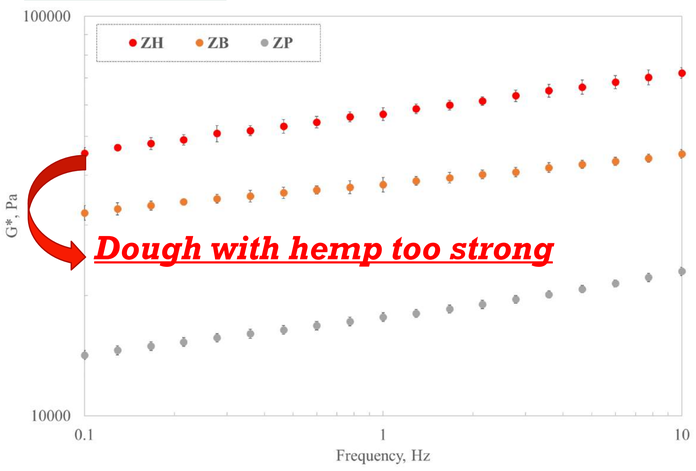
Frequency Sweep test: 25°C, 50°C , 80°C, linear region (prev. stress and time sweep tests).

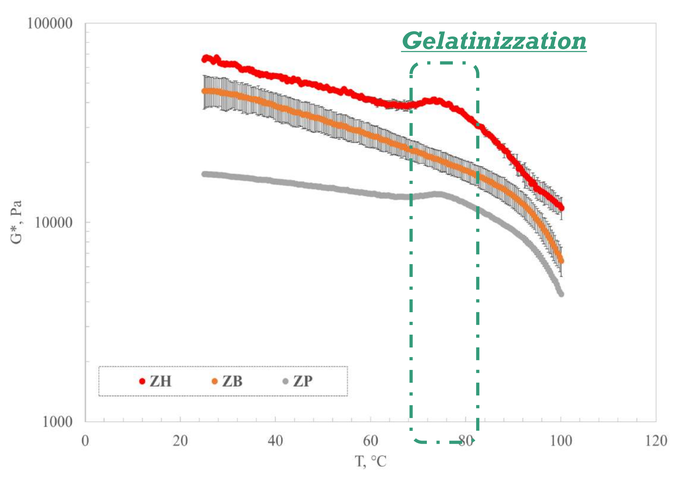
Time Cure: 25-100°C, +2°C/min, linear region.

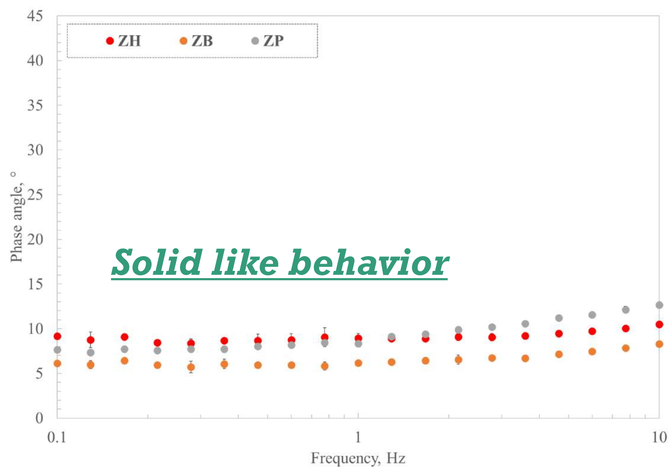
Experimental

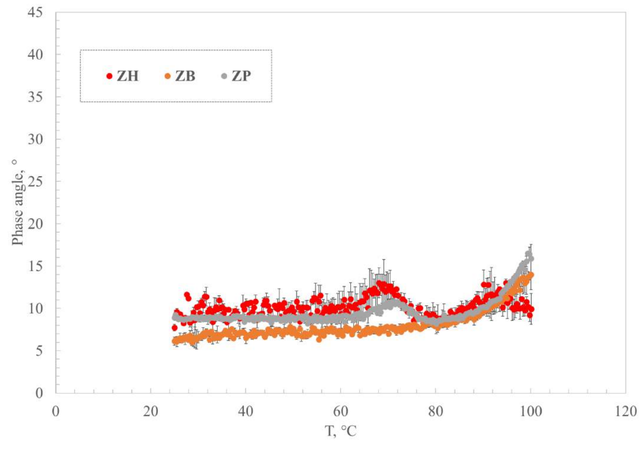


Results

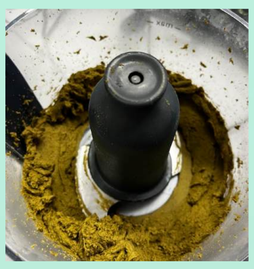








Printability Test



Living Lab Experience

- ***Good mechanical properties as ink***

- ***Using food waste, printable inks were formulated.***
- ***Brown Rice proteins were found to be the most suitable for the preparation of printable ink.***
- ***Food inks for 3D food printing make healthy food appealing to kids***

The living lab experience validated the work!

References
[1] Godoi et al. (2016), 3D printing technologies applied for food design: Status and prospects. *Journal of Food Engineering 179 (2016) 44-54.*
[2] Cheng et al. (2021), 3D food printing of fresh vegetables using food hydrocolloids for dysphagic patients. Food Hydrocolloids 114 (2021) 106546.

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