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Valérie Guenard-Lampron, Xincheng Liu

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Valérie GUÉNARD-LAMPRON¹, Xincheng LIU¹

¹Université Paris-Saclay, INRAE, AgroParisTech, UMR SayFood, 91120, Palaiseau, France

✉ valerie.guenardlampron@agroparistech.fr

INTRODUCTION

3D food printing allows the development of personalized foods in terms of shape, texture, nutritional needs and preferences. Studies have already demonstrated the interest and applicability of using a thermomechanical treatment on wheat flour recipes to obtain a printable dough¹. More complex recipes with the addition of carrot puree (20%) have also been printed and validated². However, to diversify the tastes and textures and improve the nutritional intake of these printable products, it is essential to explore matrices based on other cereals, legumes or nuts for example.

OBJECTIVES

The main objective was to diversify the nutritional and sensory properties of printable recipes using different flours and to better understand consumer appreciation of these products.

- ❑ Selection of nutritious flours (rich in protein or fiber) that can be transformed into printable dough by an optimized thermomechanical treatment.
- ❑ Describe sensory properties of 3D-printed products and evaluate their appreciation by consumers to target the ideal recipe.

METHODOLOGY

1. Bibliographic screening of 27 flours and experimental screening of 5 flours (rye, chestnut, soy, lupine and chickpea).

2. Two selected flours



3. Experimental design (10 trials per flour)

Water content:
Duration of treatment:

4. Optimized process using reverse-engineering approach (not shown here)

5. Flavoring

Addition of cinnamon for all recipes and 0 % or 20 % of apple puree

6. Printing & Baking

Nozzle diameter : 3.4 mm, filling rate : 55 %, printing speed : 10 mm.s⁻¹ (3D food printer prototype)
Oven : 175°C, 17 min



7. Characterization

Sensory profile (4 experts)
Hedonic appreciation (56 consumers)
Dough firmness (back-extrusion method, texture analyser)

RESULTS AND DISCUSSION

Sensory profile

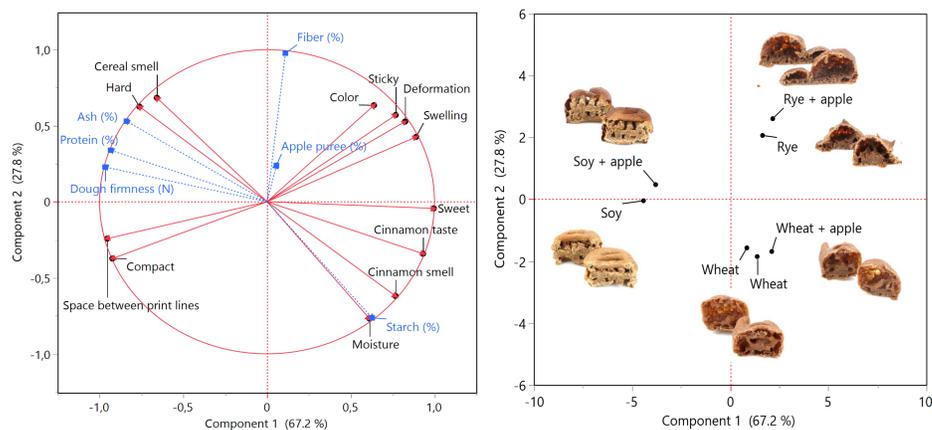


Figure 2. Correlation circle (A) and PCA map of 3D-printed and baked products

Experts generated and defined 12 sensory. Products containing apple puree were slightly different with darker color (soy) and more distorted shape (rye).

Soy flour products were more compact and harder (higher dough firmness), with a stronger cereal smell and very visible spaces between the print lines (good hold of the printing model).

Rye and wheat flour products were sweeter, but cinnamon smell and taste were stronger for wheat flour products. These were also more humid inside.

Rye flour products were darker and more sticky, swollen, airy and deformed.

Consumers tests

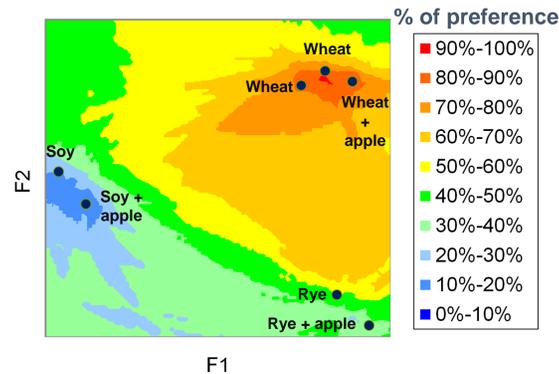


Figure 3. Preference Mapping based on the general appreciation of products by consumers

Wheat flour products are consumers' favorite (80-90%), followed by rye (30-50%) and soy (10-20%).

Little difference in appreciation of products with or without apple puree (< 10%).

From this mapping, we were able to extract the ideal values to target for each of the sensory descriptors.

Reverse-engineering approach

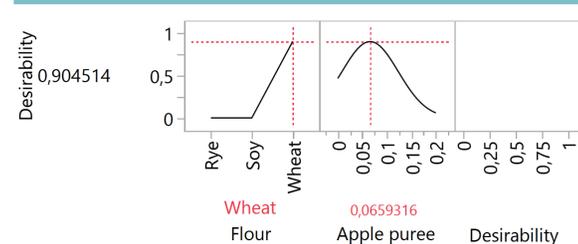


Figure 4. Optimization of the recipe according to consumer preferences

Based on the ideal values to target for each sensory descriptors and using a desirability function, we determined that consumers preferred wheat flour products with 7 % of apple puree.

ACKNOWLEDGMENTS



REFERENCES

- Masbarnat, L., Berland, S., Leverrier, C., Moulin, G., Michon, C., Almeida, G. (2021). Journal of Food Engineering, 310, 110696.
- Guénard-Lampron, V. Masson, M., Leichtnam, O., Blumenthal, D. (2021). Innovative Food Science and Emerging Technologies, 72, 102738.

CONCLUSION

- ❑ Combining printability of recipes, nutritional intake and consumer appreciation is complex, but using a reverse-engineering approach can help to target a specific recipe.
- ❑ The use of different flours has allowed a diversification of tastes, textures and visual aspects.
- ❑ Other flours such as chestnut and lentil could be interesting to test in future studies.