

# The effect of walnut skin extract on the physicochemical, antioxidant, textural and sensory properties of plant-based ice cream

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## INTRODUCTION & AIM

- Due to impacts from various aspects such as ethics, environment, health, and socio-economy, consumers worldwide have shown a further increased interest in plant-based diets [1].
- The plant-based dairy industry is projected to grow at a compound annual growth rate of 12.5 %, with global market size expected to reach \$52.58 billion by 2028. In dairy category plant-based ice cream alternatives saw the most growth in retail sales comparison by increasing 95% in 2020 [2].
- The commercial market sales of plant-based ice cream alternatives to consumers still need to be improved. Currently, the market for plant-based ice cream alternatives is mainly dominated by products made from soy [3].
- The Food and Health Survey consistently shows that taste is the number one driver behind purchase intention, more important than price, convenience, and health.
- The low sales margins indicate that the consumer market is left unsatisfied and there is substantial room for improvement and growth within this product category.



This study aims to research the impact of the walnut skin extract and other main ingredients on the product characteristics of walnut plant-based ice cream alternative, and to make a comparison between plant-based ice cream alternative and animal-based ice cream in some aspects such as pH, acidity, texture and color properties. In addition, parameters such as antioxidant property, bioactive substances, sensory attributes and correlation analysis of plant-based ice-cream formulations will be investigated in comparison with animal-based ice cream.

## METHOD

### Experimental materials

Raw walnuts, walnut oil, fibers, vanilla extract, citric acid, sugar, salt, stabilizer were procured from the local market in Chisinau, Moldova. All chemicals used within this study were purchased from Eco-Chimie and Sigma-Aldrich (Chisinau, Moldova). All the chemicals used were of HPLC or analytical grade. Distilled water was used throughout.

### Design of experiment

Response Surface Methodology (RSM) was used to investigate the main effects of walnut skin extracts and main ingredients on response variables, including pH, acidity, color attributes (L\*, a\* and b\*), total polyphenol and flavonoids content, antioxidant activity (DPPH, ABTS), texture parameters (hardness, adhesiveness, springiness, chewiness), sensory properties. The goal was to develop predictive models that maximize or minimize modifiable response variables based on independent variables, and thereby optimizing amount of ingredients for walnut plant-based ice cream alternatives making (Table 1).

Table 1. Variables for walnut plant-based ice cream formulations

Variables	Units	Levels			
		Minimum	Maximum	Coded Low	Coded High
Walnuts/Water ratio	[c.u.]	0.07	0.39	0.14	0.33
Walnut oil	[%]	11.64	18.36	13.00	17.00
Walnut skin extract	[%]	1.16	2.84	1.50	2.50

### Statistical Analysis

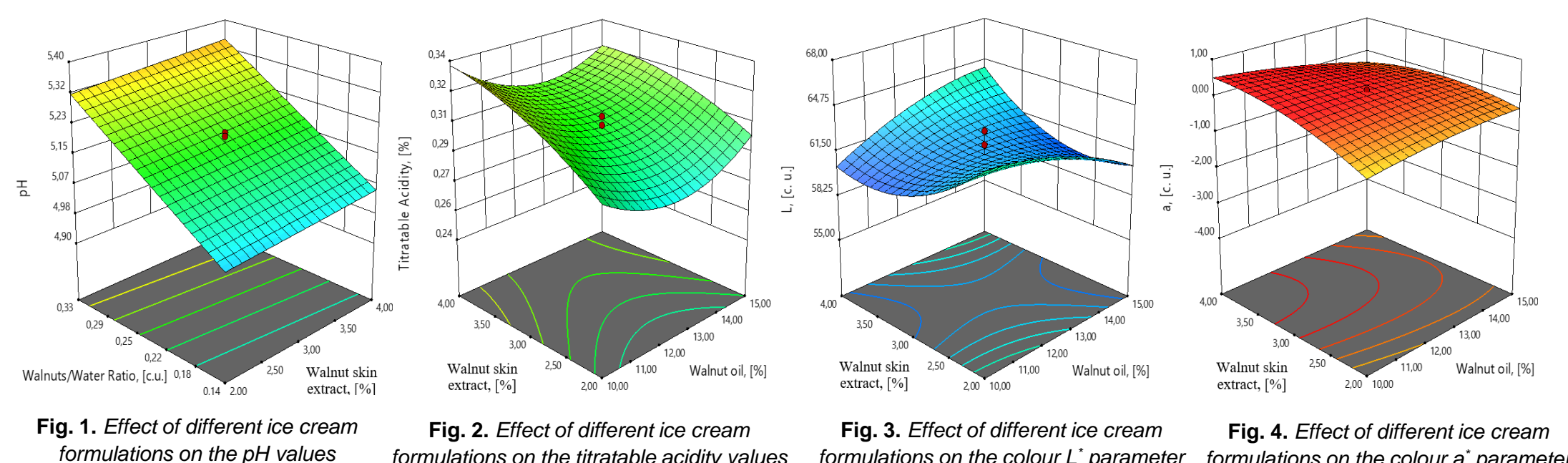
- All experiments were carried out at least in triplicate and expressed results in mean±standard deviation.
- Design-expert software (v.13.0.5.0, USA) was used to design the experiments and statistical analysis of the findings.
- The statistical significance was determined by variance analysis (ANOVA).
- The significant differences between the mean values were accepted at the ( $p < 0.05$ ) probability level with a confidence level of 95 %.

## ACKNOWLEDGMENTS

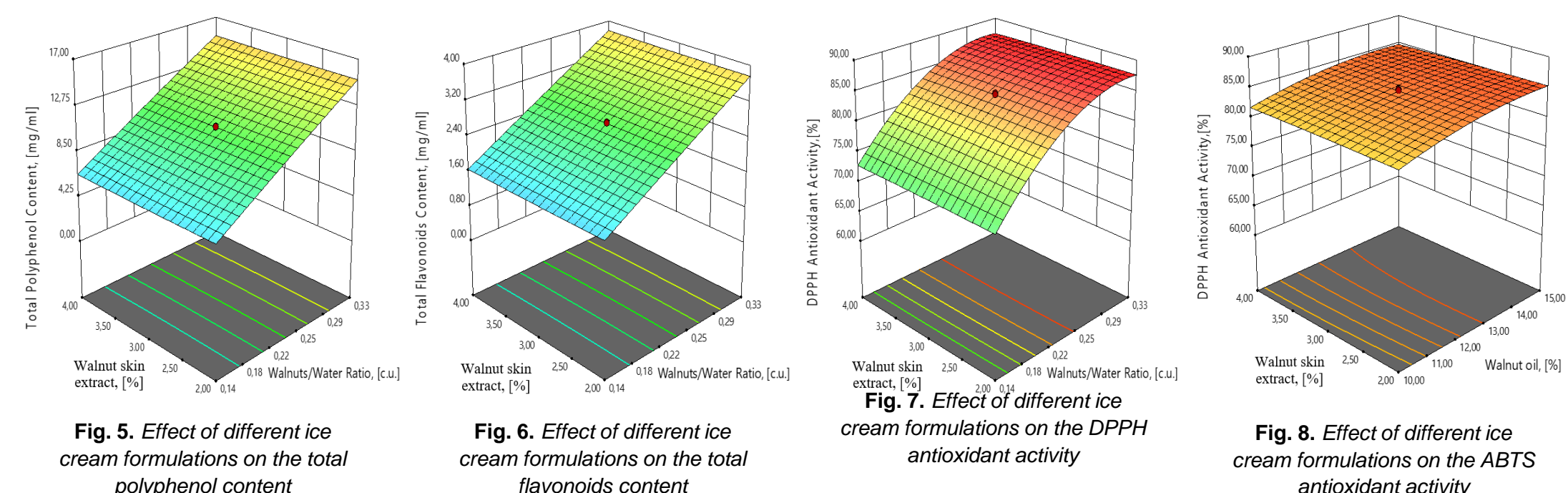
This research was supported by the Institutional Project, subprogram 020405 “Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, implemented at the Technical University of Moldova.

## RESULTS & DISCUSSION

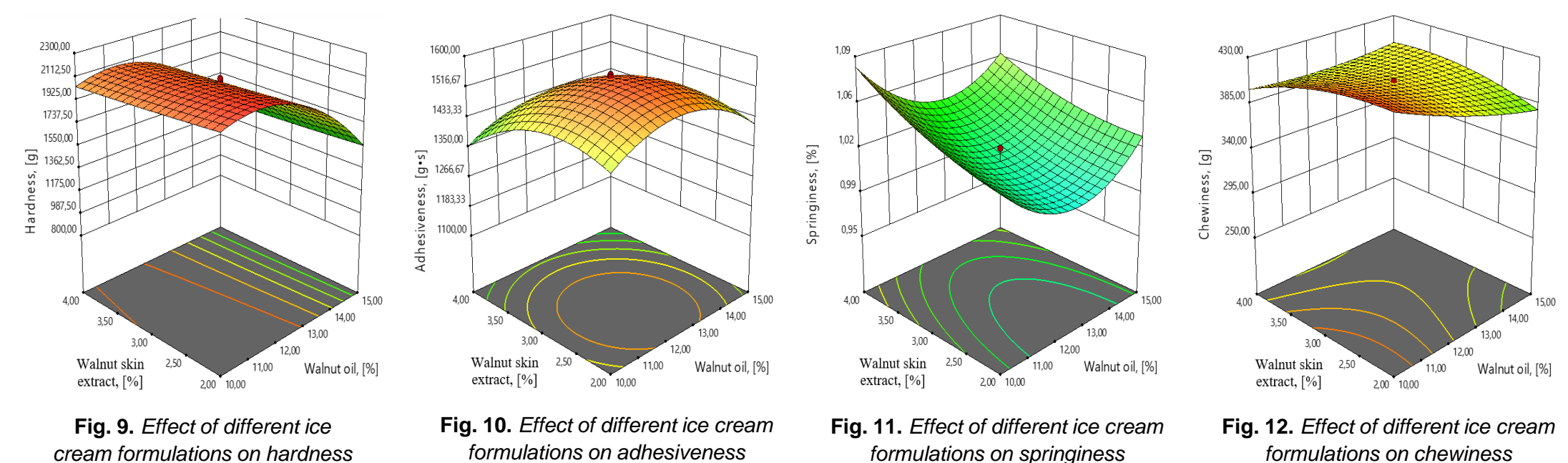
### Effects of different ice cream formulations on the physicochemical characteristics



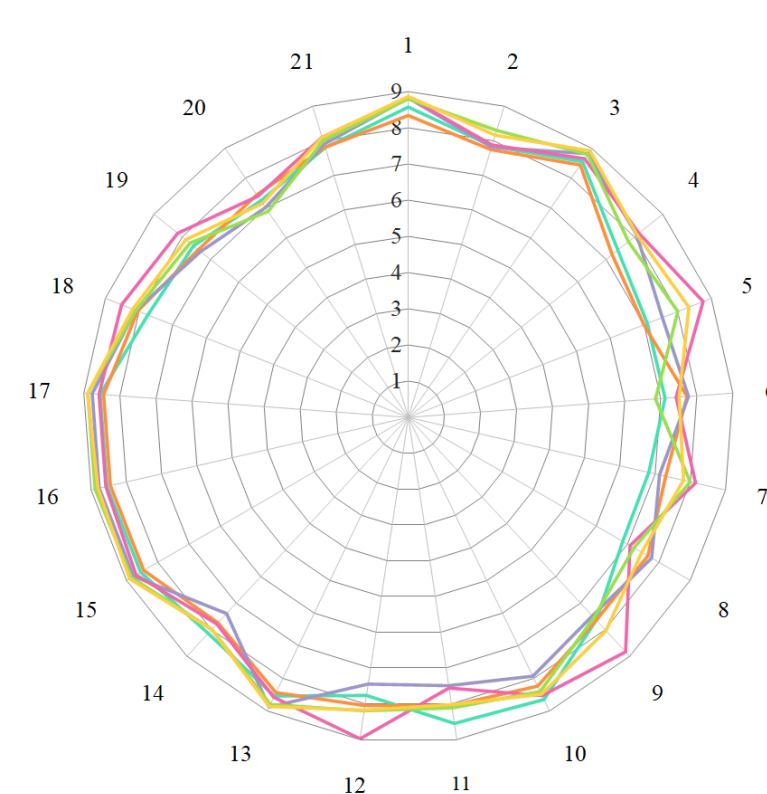
### Effects of different ice cream formulations on the antioxidant potential



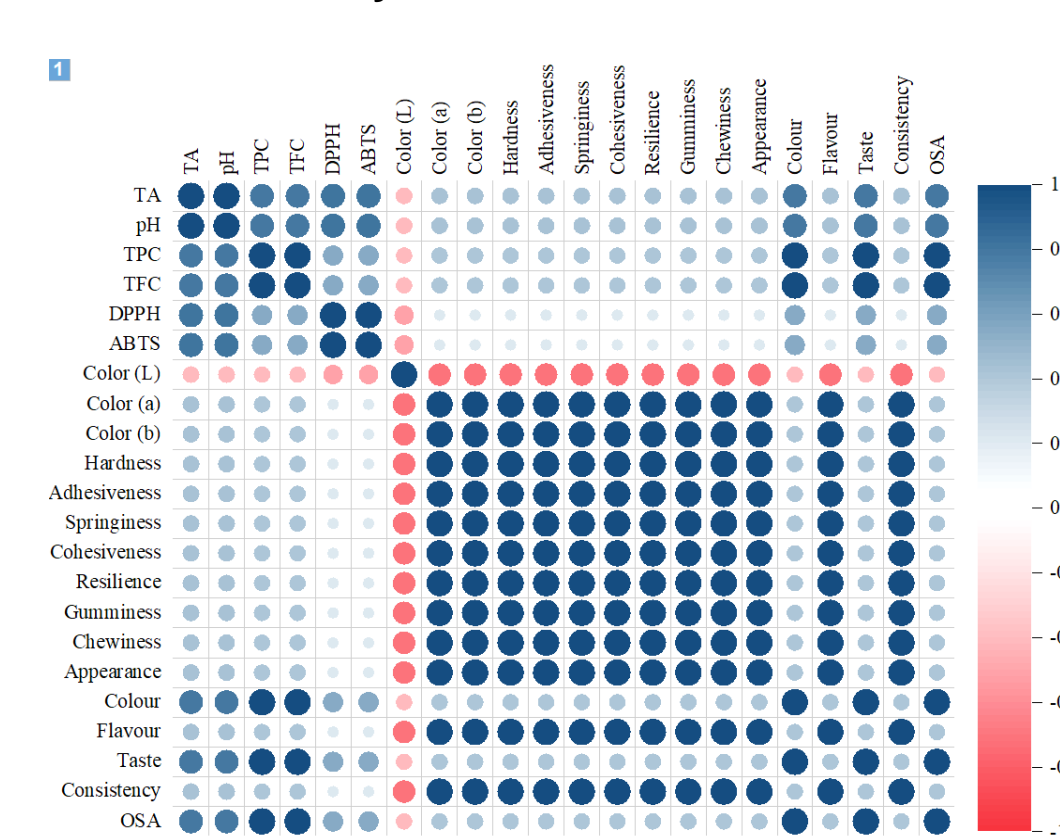
### Effects of different ice cream formulations on the texture parameters



### Effects of different ice cream formulations on sensory attributes



### Correlation analysis



## CONCLUSION

This study aimed to explore the antioxidant potential of walnuts skin extract for plant-based ice cream alternative formulation. Through the texture profile analysis and color parameters, it revealed the significant impact of the walnuts skin extract, amount of walnut oil and walnut/water ratio on the hardness, adhesiveness, springiness and chewiness values, and L\*, a\* and B\* attributes of the walnut plant-based ice cream alternatives. The findings indicated that the incorporation of walnut milk with higher walnuts/water ratio enhanced the hardness, springiness, and chewiness of the ice cream formulations, while simultaneously reducing its adhesiveness and optimizing its texture. This study further explored the potential applications of walnuts in plant-based ice cream alternative and introduced walnut skin extract to meet the diverse dietary needs of consumers and to improve antioxidant potential of the product. The implications of these results are significant for advancing the sustainable recovery of natural bioactive compounds from walnut skin within the plant-based ice cream industry.

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