# ΣΥΜΠΟΣ Fortifying yoghurt with orange peel bioactive compounds: A step towards sustainable functional food development

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## INTRODUCTION

In response to sustainability demands, the food industry increasingly valorizes waste rich in bioactive compounds. Orange peels, like other fruit by-products (e.g., pineapple, mango, pomegranate), are promising candidates for yoghurt fortification due to their antioxidant and aromatic properties [1].

### SCOPE

This study investigates the development of an innovative yoghurttype product enriched with orange peel bioactive compounds, aiming to improve its functional properties while maintaining highquality standards.

### METHODS

Orange

the

obtained

extraction,

concentration

compounds

activity (Picture 1).

peel

via

evaluation of

extract

following

optimization process involving

EtOH-to-H<sub>2</sub>O ratios (30/70 to)

80/20 v/v) to maximize the

and

of

green solvents

was

an

different

phenolic

antioxidant

### DECII





1. Freeze-drying of fresh orange peels





4.Filtration

5.Solvent evaporation 6. Freeze-dried powder of orange peels bioactive compounds

centrifugation

### Picture 1: Extraction of orange peels waste bioactive compounds





Picture 2: Yoghurt production incorporating orange peel bioactive compounds

milk Goat yoghurt-type products enriched with different concentrations of orange peel extract in powder (0.5-4.5%)were formulated and evaluated for their bioactive compound and content sensory characteristics.

For the selected optimally fortified yoghurt-type products and control yoghurts, a shelf-life study was conducted, during which the yoghurts were stored at temperatures 1-10°C and periodically analysed for microbiological, physicochemical, nutritional and sensory parameters (Picture 2).

### KESULIS

A freeze-dried powder rich in bioactive compounds (total phenolics: 32.8 mg/g dm, antioxidant activity: 10.1 mg/g dm) was extracted from orange peel wastes exposed under the optimized EtOH-to-H<sub>2</sub>O ratio of 60/40 v/v at 25°C for 20 min. A 1% fortification level was selected as optimum providing the best balance between enhanced functional properties and sensory acceptability (optimal flavour balance with minimal bitterness) (Figure 1).



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All the developed yoghurt-type products were of superior quality, with quality indices comparable to those of control yoghurts. The starter culture's viability remained unaffected by the powder's addition to milk.

**Figure 1**: Effect of different fortification levels (%) on total phenols and antioxidants extraction of orange peels waste. Sensory evaluation

The fortified products exhibited significantly higher concentrations of phenolic compounds and antioxidant activity compared to the control, with both values exceeding control levels by more than 2.5fold (Figure 2). Vitamin C content was ~50% higher in the fortified products. The incorporation of bioactive powder promoted higher viability of lactic acid bacteria throughout storage. Considering the FAO recommendation of 10<sup>7</sup> CFU/g as the minimum threshold for lactic acid bacteria viability [2], the addition of bioactive compounds led to a prolonged shelf life by ~15 days at 4°C-double that of conventional goat milk yoghurt (Figure 3).

### CONCLUSIONS

The findings demonstrate that fruit waste, particularly orange peels, can serve as a valuable source of functional ingredients for the development of high-quality, health-promoting food products. This approach also supports waste reduction, resource efficiency, and innovation in food production.



Figure 2: Effect of storage at 4°C on the antioxidant activity of yoghurt and yoghurttype products



Figure 3: Effect of orange peel extract on the shelf-life of yoghurt-type products

## AKNOWLEDGEMENTS

This project has received funding from the European Union's Horizon Europe research and innovation program EXCEL4MED under grant agreement No 101087147.



**Funded by** the European Union



## REFERENCES

1.Ferreira, S.M. & Santos, L. (2023). Food Biosci., 51, Article 102293

2.Codex Alimentarius Commission (2022). Codex standard for fermented milks (CODEX STAN 243-2003, Rev. 2022). FAO/WHO.