Foods 2024 Conference

The 5th International Electronic Conference on Foods

28–30 October 2024 | Online

MDPI

Optimizing Carotenoid and Amino Acid Extraction from Tomato Waste for Biostimulant Production

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INTRODUCTION & AIM

The food industry produces a substantial amount of vegetable waste, estimated to be between 2% and 5% of its total annual production. This waste generation leads to both environmental challenges, such as increased pollution, and economic concerns, due to the cost of disposal and lost potential value. One promising approach to address these issues is the revalorization of food waste by converting it into valuable bioproducts, such as biostimulants for agricultural use. Tomato waste, in particular, is rich in bioactive compounds, amino acids, and essential micronutrients, all of which have the potential to enhance crop yields, improve plants' ability to cope with stress, and increase the quality of fruits when applied to agricultural fields.

The aim of this study was to explore different strategies including enzymatic treatment to optimize the extraction of carotenoids and/or amino acids from tomato waste, with the aim of formulating an effective biostimulant product.

MATERIAL & METHODS

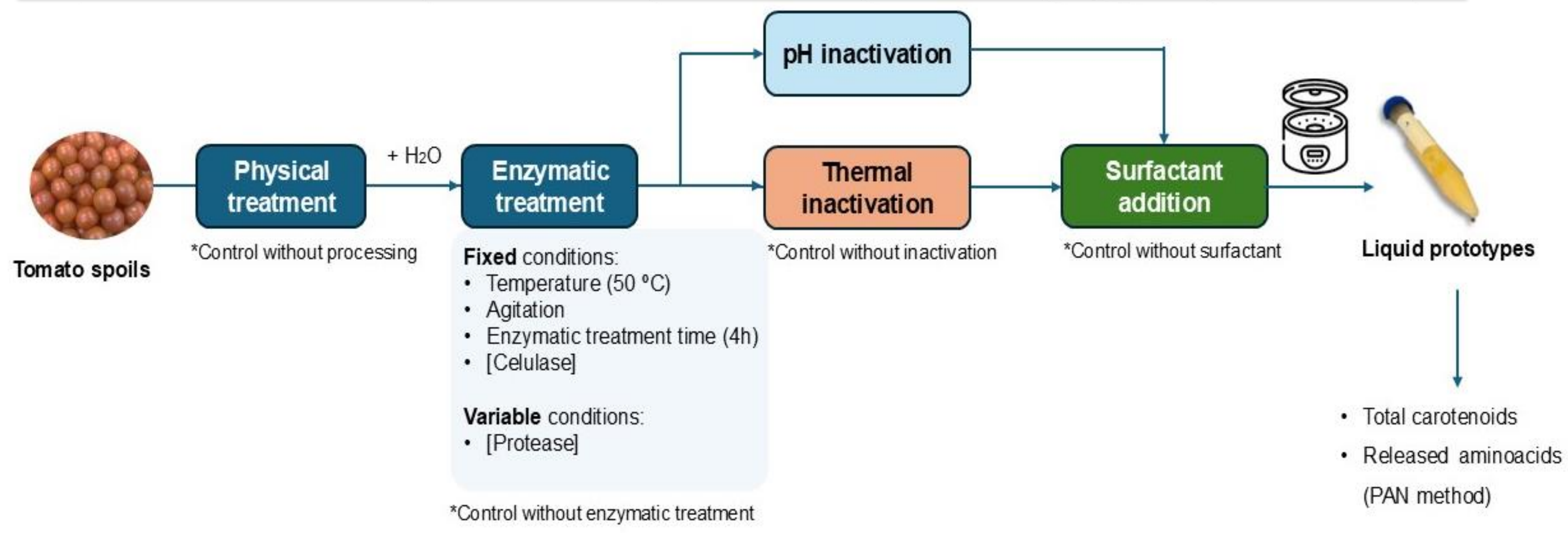

Table 1. Obtained prototypes after applying different conditions (protease concentration, inactivation method or addition of surfactant).

Nº	Prototype	[protease]	Incubation	Inactivation	Surfactant	Format
1	CP1TTw	x 1	✓	Thermal	✓	Liquid
2	CP2TTw	x 10	✓	Thermal	✓	Liquid
3	CP1BTw	x 1	✓	pH	✓	Liquid
4	CP1T	x 1	✓	Thermal	✗	Liquid
5	(CP1)sa TTw	x 1	✗	Thermal	✓	Liquid
6	CoTo	0	✓	✗	✗	Liquid

RESULTS & DISCUSSION

The increase in enzyme concentration enhanced carotenoid extraction (Figure 1A) probably due to the hydrolysis of polysaccharides in tomato cell walls, allowing easier release of carotenoids [1]. Higher protease levels (prototype 2) improved carotenoid content more than prototype 3, likely due to greater proteolytic activity that improve the release of carotenoids bound to the chromoplasts. Likewise, thermal treatments at 90-95°C also helped break carotenoid-protein complexes, facilitating carotenoid release and encapsulation in the surfactant [2, 3].

The addition of surfactant was key for solubilizing both carotenoids and proteins, as prototypes without surfactant showed the lowest levels (Figure 1A, B). In addition, enzyme concentration and inactivation method also affect the content of amino terminal groups. The results showed that protein solubilization was greater when a combination of enzyme and surfactant addition, along with thermal inactivation, was used (prototypes 1 and 2), whereas basification was not effective enough for solubilizing proteins.

Therefore, obtained prototypes could serve as potential extract to formulate bioestimulants, since it contains bioactive compounds and main amino acids found in tomato such as L-Asp, L-Glu and L-Ala, which have proven effects on nutrients absorption and chlorophyll production in crops [4].

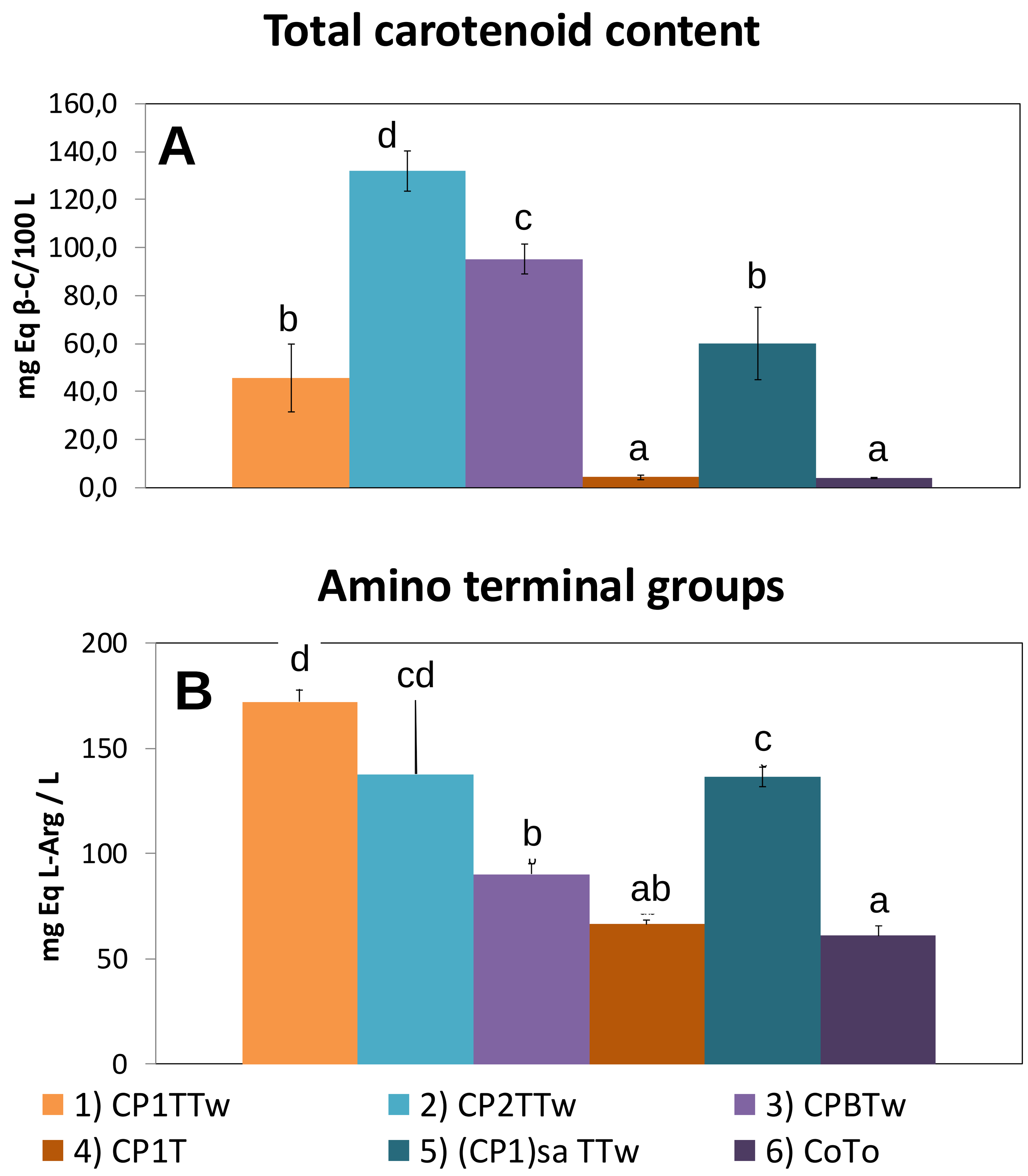

Figure 1. A) Total carotenoid content (mg Eq.β–carotene/100 L) found in each prototype. B) Amino terminal groups content (mg Eq. L-Arg/L) found in each prototype. Different letters (p<0.05) indicate significant differences among treatments.

CONCLUSION

To conclude, applying enzymatic hydrolysis with a combination of cellulases and proteases, together with heat treatment and the addition of surfactant was effective in enhancing the extraction of carotenoids and amino acids from tomato waste, facilitating their use in the formulation of biostimulants.

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ACKNOWLEDGEMENTS

This research was funded by Junta de Andalucía and the European Union (FEADER), grant number GOPG-GR-23-0005 (GO TOMAGROUP). G.L.G. postdoctoral contract belongs to Juan de la Cierva Formación-2021 (FJC2021-047564-I) funded by MCIN/AEI/10.13039/501100011033 and European Union “NextGenerationEU/PRTR”. M.A.L.B. is grateful to “Consejería de Transformación Económica, Industria, Conocimiento y Universidades de la Junta de Andalucía” for her post-doctoral contract (POSTDOC_21_00031).