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Natural-based strategies in pre- and post-harvest handling and value addition of subtropical crops.

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INTRODUCTION

Subtropical fruits, such as mango and avocado fruits, contain nutrients that provide healthy biological properties and a high antioxidant capacity, but their limited life after harvesting make these fruits targets of research lines to look for effective post-harvest handling. On the other hand, the high production rates of the agri-food sector and the demands of the market require the development of new strategies aimed at improving and maintaining the quality of fruit and ensuring the sustainability and low environmental impact. In response to this challenge, **EcoSkin project** has been created among 4 entities including a primary producer, fertilizer company, research center and foundation, with the common objective of developing sustainable and effective strategies that will allow farmers to produce a high-quality subtropical fruit and ensure its safety and a long shelf-life. In addition, in line with current circular economy policies, the project aims to give a second life to the by-products generated during cultivation and to develop extracts with agronomic potential.

Figure 1. Avocado and mango by-products studied.

Figure 2. Edible coating applications in fruits.

METHODOLOGY

A complete study was carried out of the main by-products generated during the cultivation of mangos and avocados (pruning residues and fruit wastes) by means of a complete physicochemical characterization (organic matter, pH, phenolic content and antioxidant activity, etc.). These wastes were then subjected to two extraction protocols: I) aqueous extraction and II) ethanolic extraction, after which a phytochemical screening was carried out to determine the presence of compounds of agronomic interest (alkaloids, phenols, tannins, etc.). The development and formulation of new products with agronomic application are currently in progress. Conversely, other study was carried out on preservation protocols and the extension of the shelf-life of subtropical fruits through the application of coatings based on natural extracts. These coatings were applied to the fruit by immersion at the established dose (3 cc/l) and stored under refrigeration for 21 days. Finally, several parameters were monitored to determine the suitability of the formulations (firmness, color, acidity, visual appearance, ºBrix, etc.).

RESULTS AND DISCUSSION

Among all the characterized waste materials (leaves, skins and stones of avocado crops and peels of mango fruits), **higher phenolic content of the mango peel** (5.1 mg a.g/g) compared to the rest of the avocado by-products (~1.5 mg a.g/g) was highlighted as a **potential biostimulant ingredient**. On the other hand, considering the high biocidal potential of alkaloids and tannins, aqueous extracts of avocado leaf and mango skin and ethanolic extracts of avocado skin and stone were selected to formulate new prototypes with **biocidal capacity** (currently in progress) (Figure 1). Additionally, regarding the post-harvest applications, several prototypes of **coatings based on natural compounds** were developed and assessed to determine their feasibility of an extension of shelf-life period in subtropical fruits. In these trials, physicochemical and **deterioration changes during storage were less pronounced in fruit treated** with some of the prototypes to be tested, showing an **improvement in post-harvest quality parameters** (such as weight loss, firmness, visual quality, respiration rate, or dry matter) compared to the control (untreated fruit). Based on these results, new prototypes will be formulated and/or reformulated for further post-harvest trials (currently in progress).

	Avocado						Mango	
	Leaves		Piel		Stone		Peel	
	H_2O	EtOH	H_2O	EtOH	H_2O	EtOH	H_2O	EtOH
Alkaloids	+	+	+	+	+	+	+	+
Flavonoids	-	-	-	+	-	-	++	-
Glycosides	-	-	-	-	-	-	-	-
Terpenoids	-	-	-	-	+	++	-	-
Tannins	-	+	-	-	-	-	+	+
Coumarins	+	-	-	-	-	-	+	+
Saponins	+	-	-	-	+	-	-	-
Steroids	-	-	-	-	-	+	-	-
Anthraquinones	-	-	-	-	-	-	+	+

Figure 1. Qualitative analysis of the different phytochemical compounds in the extracts evaluated.

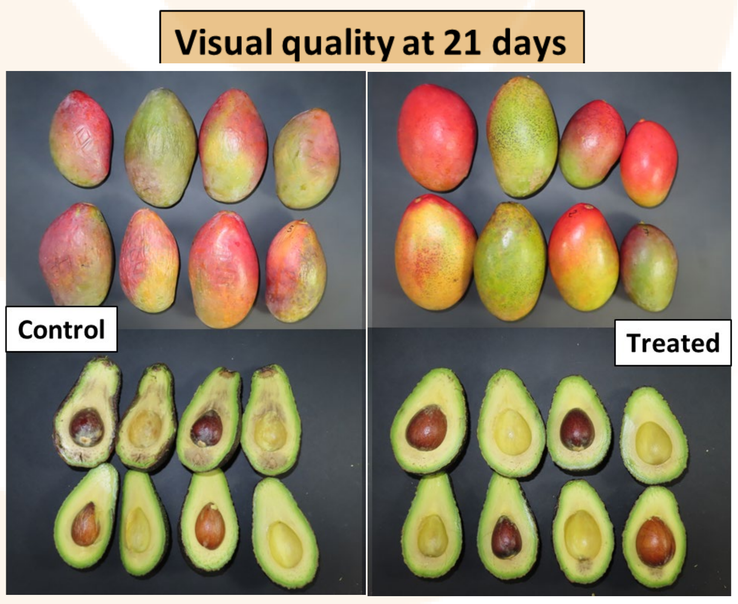
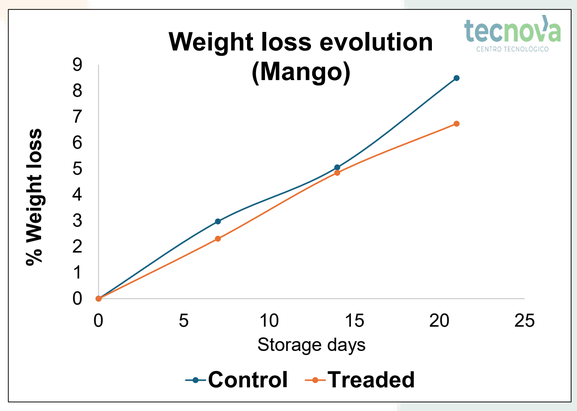


Figure 4. Visual quality of mango and avocado fruits at 21 days of storage; control (left) and treated (right).



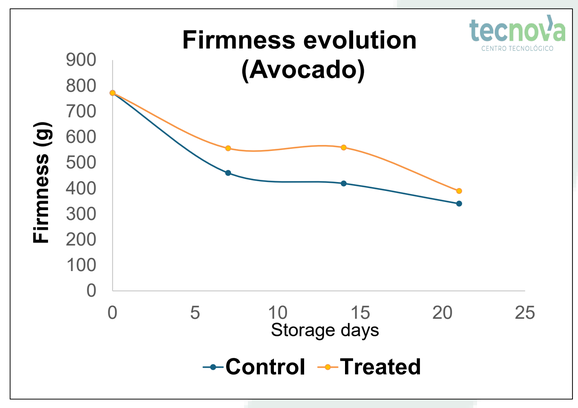


Figure 3. Weight loss and firmness evolution during postharvest shelf life of mango (left) and avocado (right).

CONCLUSIONS

The use of different **subtropical wastes** seems to be **valuable ingredients to be included in agronomic formulations** with interesting biocidal properties. Although no final conclusions can be drawn due to the lack of conclusive data, it is expected **that natural coating prototypes designed for post-harvest applications can be effective to reduce weight loss during the shelf-life** and to **improve the texture** of the targeted subtropical fruits, and hence, **extend their useful life**.

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