

# The influence of 1-Naphthaleneacetic acid on recovering 'Rocha' pear ripening after 1-MCP treatment

Cindy Dias<sup>1</sup>, Tânia Ribeiro<sup>1</sup>, Ana Cristina Rodrigues<sup>2,3</sup>, Marta W. Vasconcelos<sup>1</sup>, António Ferrante<sup>4</sup>, Manuela Pintado<sup>1</sup>

<sup>1</sup> Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa/Porto, Portugal;

<sup>2</sup> Rocha Center, Centro de pós-colheita e tecnologia, ACE; <sup>3</sup> Center for Innovative Care and Health Technology (ciTechcare), Polytechnic of Leiria, Leiria, Portugal

<sup>4</sup> Università Delgi Studi di Milano, Dipartimento di Scienze Agrarie e Ambientali (DISAA), Milano, Italia

cdias@ucp.pt

## Introduction

A continuing challenge for the pear industry, in particular 'Rocha' pear sector, is how to initiate ripening in 1-MCP treated fruit. 1-MCP irreversibly binds to ethylene receptors, avoiding fruit ripening. Consequently, its eating quality is compromised leading to consumers rejection and postharvest losses. This work purpose was to evaluate the 1-Naphthaleneacetic (1-NAA) auxin effect on improving the 'Rocha' pear ripening treated with 1-MCP.

## Mat & Methods

'Rocha' pear previously treated with 1-MCP were immersed in aqueous 1-NAA at 0.745 g L<sup>-1</sup> for 2h, and then stored at 23 °C (RT) and analyzed after 7 and 15 days. Established ripening indicators, including firmness, ethylene production, sugars along with the activity and genetic expression of the ethylene biosynthesis enzymes (1-aminocyclopropane-1-carboxylic acid synthase, ACS; 1-aminocyclopropane-1-carboxylic acid oxidase, ACO) and receptors (*PcETR1*, *PcETR2* and *PcETR5*) were analyzed over the course of ripening after 1-NAA treatment.

## Results

**Ripening induction by the auxin treatment**, is suggested from around **60% of fruit firmness loss** and around **50% increased internal ethylene** production compared to the pears only treated with 1-MCP (Tab. 1). Also, observing Fig. 1, ripening promotion by 1-NAA is demonstrated by the significant **higher concentration of saccharose**, one of the main sugars associated to ripening.

Tab. 1 Firmness and ethylene production of 'Rocha' pear stored at RT for 0, 7 and 15 days

	Days at RT		
	0	7	15
<b>Firmness (N)</b>			
CTRL (1-MCP)	35.48 ± 4.41 <sup>a</sup>	34.51 ± 8.37 <sup>a</sup>	32.00 ± 2.63 <sup>a</sup>
1-NAA	35.48 ± 4.41 <sup>a</sup>	33.57 ± 3.24 <sup>a</sup>	13.25 ± 4.68 <sup>b</sup>
<b>Ethylene (µL kg<sup>-1</sup> h<sup>-1</sup>)</b>			
CTRL (1-MCP)	0.40 ± 0.07 <sup>a</sup>	0.57 ± 0.12 <sup>a</sup>	5.44 ± 0.07 <sup>a</sup>
1-NAA	0.40 ± 0.07 <sup>a</sup>	3.86 ± 0.78 <sup>b</sup>	10.59 ± 2.87 <sup>b</sup>

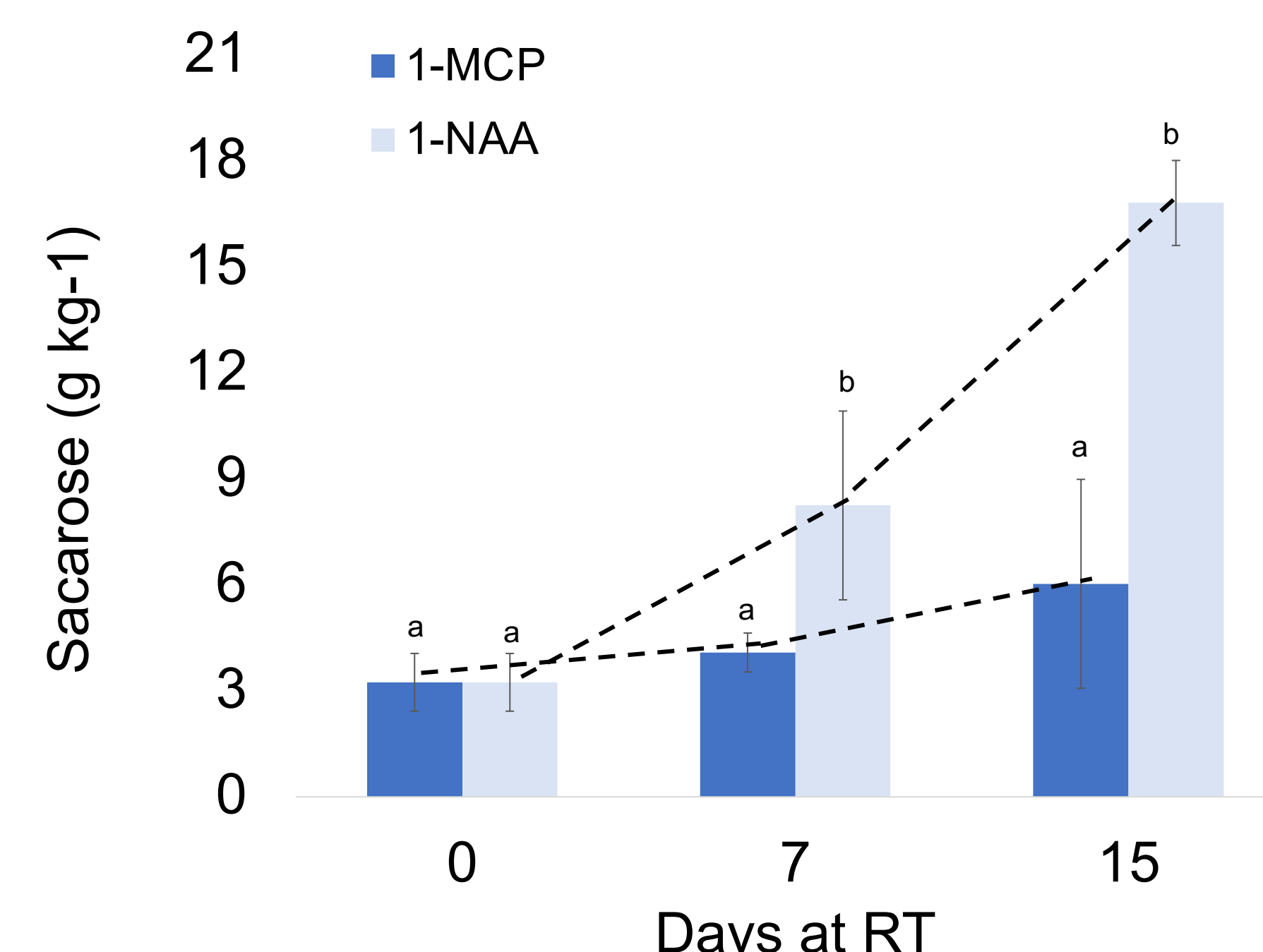


Fig. 1 Sacarose variation in pear treated with only with 1-MCP and with 1-MCP + 1-NAA.

## Results

Tab. 2 Genetic expression of ethylene receptors (ETR's) and ethylene biosynthesis enzymes (ACO and ACS)

Days at RT	Genetic expression (2 <sup>ΔΔct</sup> )							
	1-MCP				1-NAA			
	ETR1	ETR2	ACS4	ACO	ETR1	ETR2	ACS4	ACO
0	1.06 ± 0.14 <sup>a</sup>	1.10 ± 0.27 <sup>a</sup>	0.64 ± 0.12 <sup>a</sup>	1.09 ± 0.18 <sup>a</sup>	1.06 ± 0.14 <sup>a</sup>	1.10 ± 0.27 <sup>a</sup>	0.64 ± 0.12 <sup>a</sup>	1.09 ± 0.18 <sup>a</sup>
7	0.54 ± 0.14 <sup>a</sup>	1.93 ± 0.55 <sup>a</sup>	0.94 ± 0.17 <sup>a</sup>	0.72 ± 0.08 <sup>a</sup>	0.64 ± 0.06 <sup>a</sup>	2.95 ± 0.88 <sup>b</sup>	7.74 ± 1.63 <sup>b</sup>	2.02 ± 0.63 <sup>b</sup>
15	0.57 ± 0.05 <sup>a</sup>	1.59 ± 0.55 <sup>a</sup>	1.94 ± 0.41 <sup>a</sup>	0.20 ± 0.01 <sup>a</sup>	0.51 ± 0.09 <sup>a</sup>	2.85 ± 0.27 <sup>b</sup>	127.16 ± 1.63 <sup>b</sup>	7.51 ± 0.28 <sup>b</sup>

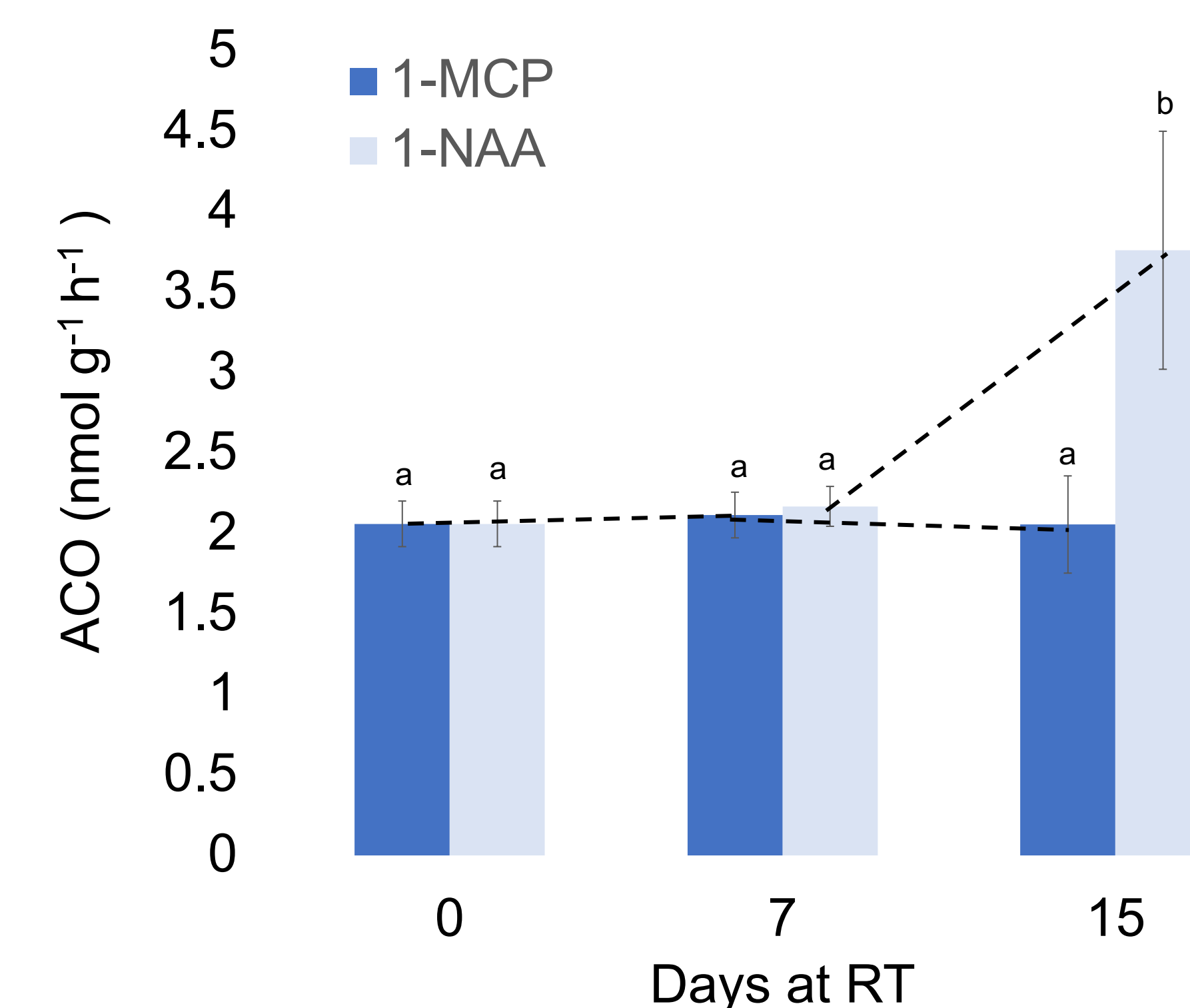
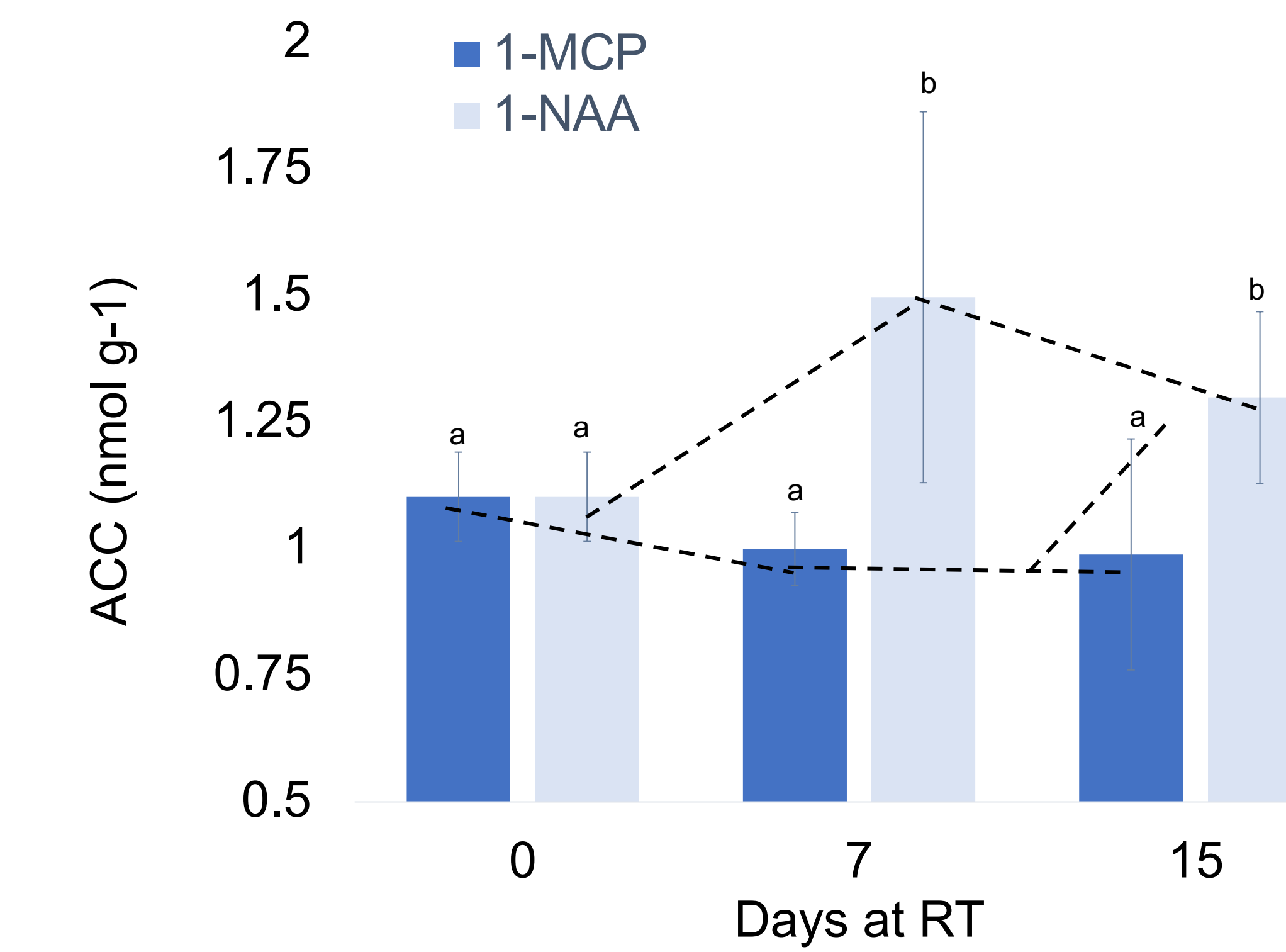


Fig. 2 ACC concentration of pear stored at RT for 0, 7 and 15 days



**1-NAA promoted increased ETR2, ACS 4 and ACO genes expression level** (Tab. 2) that **corroborates the physiological results. 1-NAA also promoted higher ACO activity after 15 days at RT corroborating the higher ethylene production** (Fig. 2). **ACC content** (Fig. 3), despite not accompanying the profile of ACO activity revealed **higher content in NAA treated pear**, contributing in some part to the **higher ethylene production**.

## Conclusions and perspectives

An overall **impact on ripening** promoted by **1-NAA** post-1-MCP is observed, especially on **firmness, ethylene production, ETR2, ACS4 and ACO genetic expression and ACO activity**. Hence, 1-NAA facilitates the initiation of ripening blocked by 1-MCP, possibly by enhancing the sensitivity to ethylene, opening mechanisms for consistent ripening of 'Rocha' pear, and possibly other fruits.