Antioxidants were efficient in reducing browning and increasing the shelf life in minimally processed arracacha (*Arracacia xanthorrhiza* Bancroft)

Aline Priscilla Gomes da Silva[1*], Jaqueline Visioni Tezotto-Uliana[2], Thais Helena de Araujo[3], William Gustavo Sganzerla[4], Ricardo Alfredo Kluge[5]

[1]Department of Biosystems and Agricultural Engineering, Michigan State University, 469 Wilson Road, East Lansing, MI 48824. E-mails: gomesdas@msu.edu, alinepgsilva@gmail.com

[2]College of Higher Education Santa Bárbara, Tatuí, São Paulo, Brazil. E-mail: jaqueline.tezotto@usp.br

[3]State University of Minas Gerais, Passos, Minas Gerais, Brazil. E-mail: thais.helena@uemg.br

[4]School of Food Engineering, University of Campinas (UNICAMP), Monteiro Lobato St., N.80, 13083-862, Campinas, São Paulo State, Brazil. E-mail: sganzerla.william@gmail.com

[5]Department of Biological Sciences, Escola Superior de Agricultura 'Luiz de Queiroz' – University of Sao Paulo, Pádua Dias 11, 13.418-900 Piracicaba, Sao Paulo, Brazil. E-mail: rakluge@*usp*.br
*Corresponding author: gomesdas@msu.edu, alinepgsilva@gmail.com

Antioxidants were efficient in reducing browning and increasing the shelf life in minimally processed arracacha (*Arracacia xanthorrhiza* Bancroft)

Minimally Processed Arracacha

- Postharvest preservation for this highly perishable product.
- Maintenance of the high nutritional value.
- To acquire valuable data on their postharvest behavior to facilitate future studies related to the nutritional values of foods, aiming the recommendations on their consumption.

Postharvest

- The roots were harvested, sanitized, and cut into 10 mm slices (± 1 mm).
- The slices were submitted to the treatments with citric acid (CA) 1%, ascorbic acid (AA) 1%, ethylenediaminetetraacetic acid (EDTA) 1%, and analyzed for six days of storage.

Analysis

- Physicochemical: Weight loss, color parameters, visual appearance, rot, pH, total soluble solids (TSS), and total sugars.
- Enzymatic: polyphenoloxidase (PPO), peroxidase (POD), and phenylalanine ammonia-lyase (PAL).

Abstract: Arracacha (*Arracacia xanthorrhiza* Bancroft) is a nutritional crop with high energy value and good digestibility. However, this plant has a short shelf life due to excessive weight loss, browning, and disease incidence. Therefore, the aim of this study was to investigate the effect of antioxidant compounds in the preservation of minimally processed arracacha during storage. The roots were harvest, sanitized, and cut into 10 mm slices (± 1 mm). The slices were submitted to the treatments with citric acid (CA) 1%, ascorbic acid (AA) 1%, ethylenediaminetetraacetic acid (EDTA) 1%, and distilled water (control). Weight loss, color parameters (L*, a*, and b*), visual appearance, pH, total soluble solids, total sugars, polyphenoloxidase (PPO), peroxidase (POD), phenylalanine ammonia-lyase (PAL) were analyzed. Hence, the samples were discriminated by multivariate analysis to determine the effect of antioxidants during the storage time. The results showed that antioxidants controlled the fresh mass loss of arracacha. On the sixth day of storage, arracachas treated with EDTA had the highest b* and L* color parameters, indicating that they were more yellow and brighter when compared with the other treatments. The visual notes (appearance and decay) for the antioxidant treatments were better than the control (without antioxidants). The influence of antioxidants on PPO and POD enzyme activity was very similar, and both enzymes showed high activity for the control treatment (2-fold higher than the samples with antioxidants). By multivariate approach, samples were discriminated mainly into two groups. The first major group corresponding to the initial day of the experiment and second major group associated with the last day of storage. The appearance and color parameters were the most crucial factors for samples discrimination in the first group, while for the second group, PAL, weight loss, and sugars were the variables responsible for the multivariate discrimination. In conclusion, the use of EDTA is the most indicated antioxidant to delay the browning reactions and increase the shelf life of minimally processed arracacha.

Keywords: Shelf life; Postharvest; Color; Antioxidants; Citric acid; Ascorbic acid; Ethylenediaminetetraacetic
browning agents.

Introduction

- Arracacha (*Arracacia xanthorrhiza* Bancroft) is a vegetable remarkable by the high nutritional and energetic value, rich in minerals, vitamins, fibers, and highly appreciated for its characteristic flavor and aroma. However, arracacha roots are a highly perishable product and the shelf life is very limited (Buso et al., 2014).

- In recent years, there has been a great demand for minimally processed products due to some characteristics, such as being available in smaller portions, ease of use or preparation, and physicochemical quality. However, minimal processing operations cause mechanical damage to the tissue of the products, which often accelerates senescence and deterioration, leading to discoloration and nutritional value losses.

- For this study, the effect of antioxidant compounds (CA, AA, and EDTA) in the postharvest preservation of minimally processed arracacha during storage under refrigeration was investigated.

IECHo 2022

Results and discussion

- The arracacha treated with AA showed higher weight loss (0.6 %), while the treatment with EDTA showed the lowest weight loss (0.3%) (Fig. 1a).
- EDTA had the highest b* and L* color parameters (Fig. 1b-d), indicating that they were more yellow and brighter than the other treatments.
- The visual notes (appearance and decay) (Fig. 1e) for the antioxidant treatments were better than those compared with the control (without antioxidants).
- No treatment showed wilting, confirming the fact that the treatments were able to prevent the dehydration of minimally processed arracacha (Fig. 1f).

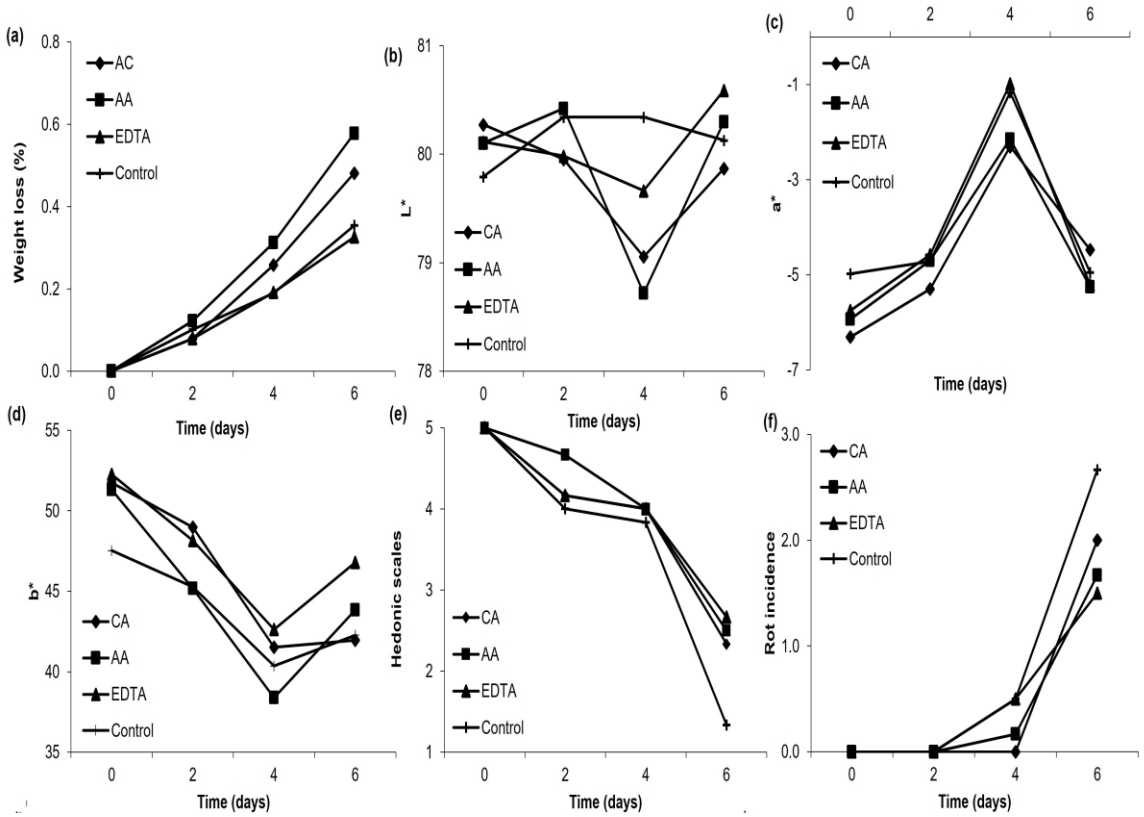

Figure 1. Analytical determinations in minimally processed arracacha treated with antioxidants and stored in a cold room (5 ± 1 ºC, 90 ± 5% RH) for six days. (a) weight loss; (b) L*; (c) a*; (d); b*; (e) visual notes; (f) rot incidence; (g) TSS; (h) pH; (i) total sugar; (j) PPO activity; (k) POD activity; and (l) PAL activity.

IECHo 2022

Results and discussion

- The TSS contents were significantly influenced by the storage time and antioxidants (Fig. 1g).
- For total sugars (Fig. 1i), the treatment composed of antioxidants showed similar contents for the total sugar at the end of storage (14.59-18.20 g glucose 100 g^{-1}). This behavior may be due to a decrease in metabolism and, consequently, in the consumption of soluble solids, the main substrates of respiration since the physical actions of minimal processing induce an increase in respiration, which will quickly use the reserve substrates (Carvalho and Lima, 2002).
- PPO activity was significant for the interaction of different antioxidants and storage days (Fig. 1j).
- The POD and PAL activities (Fig. 1k-l) was lower in the EDTA treatments treated roots at the end of storage.

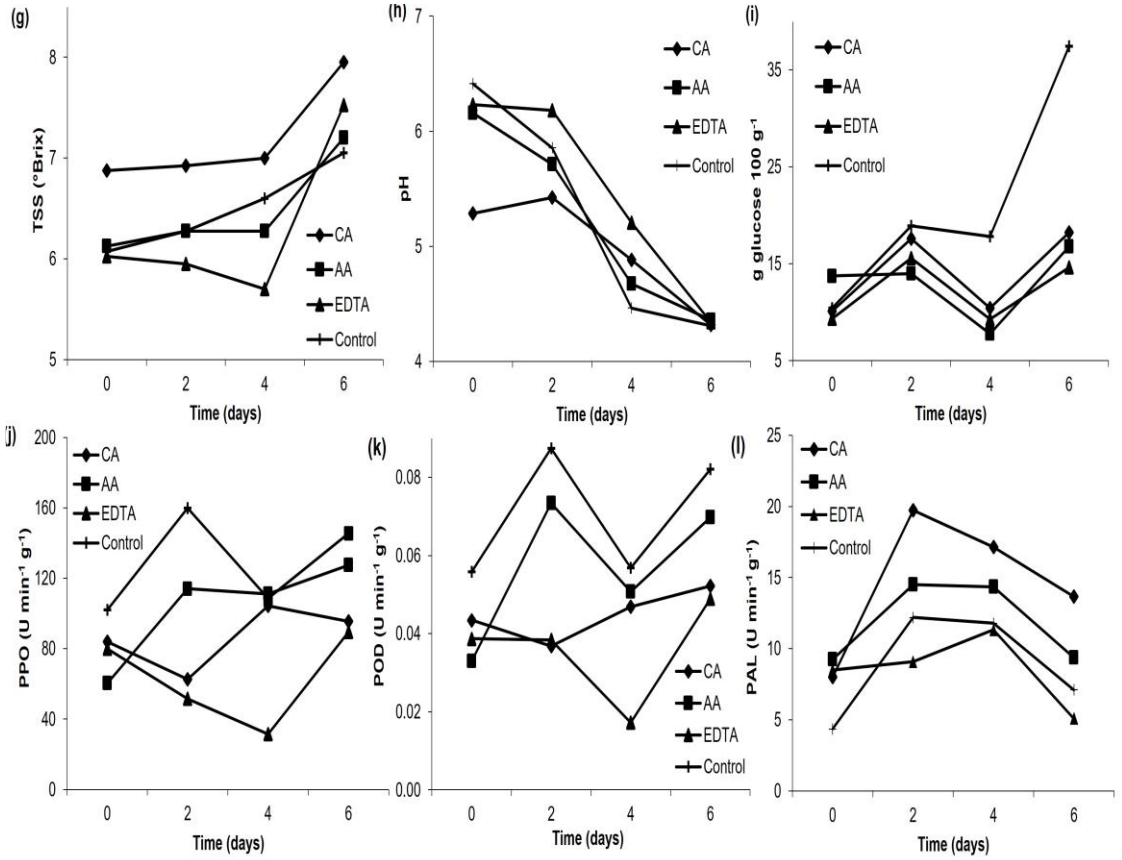

Figure 1 (cont). Analytical determinations in minimally processed arracacha treated with antioxidants and stored in a cold room (5 ± 1 ºC, 90 ± 5% RH) for six days. (a) weight loss; (b) L*; (c) a*; (d); b*; (e) visual notes; (f) rot incidence; (g) TSS; (h) pH; (i) total sugar; (j) PPO activity; (k) POD activity; and (l) PAL activity.

IECHo 2022

Results and discussion

- By multivariate approach, the graphic projection of samples demonstrates that the samples can be discriminated into two major groups composed by five minor groups (Fig. 2c).
- The PCA was explaining 72.32% of the data variability (PC1 58.06% and PC2 14.26%). The first major group corresponding to the initial day of the experiment and the second major group is associated with the sixth last day of storage.
- The appearance and color parameters were the most crucial factors for samples discrimination in the first group, while for the second group, PAL, weight loss, and sugars were the variables responsible for the discrimination of the second group (Fig. 2b).

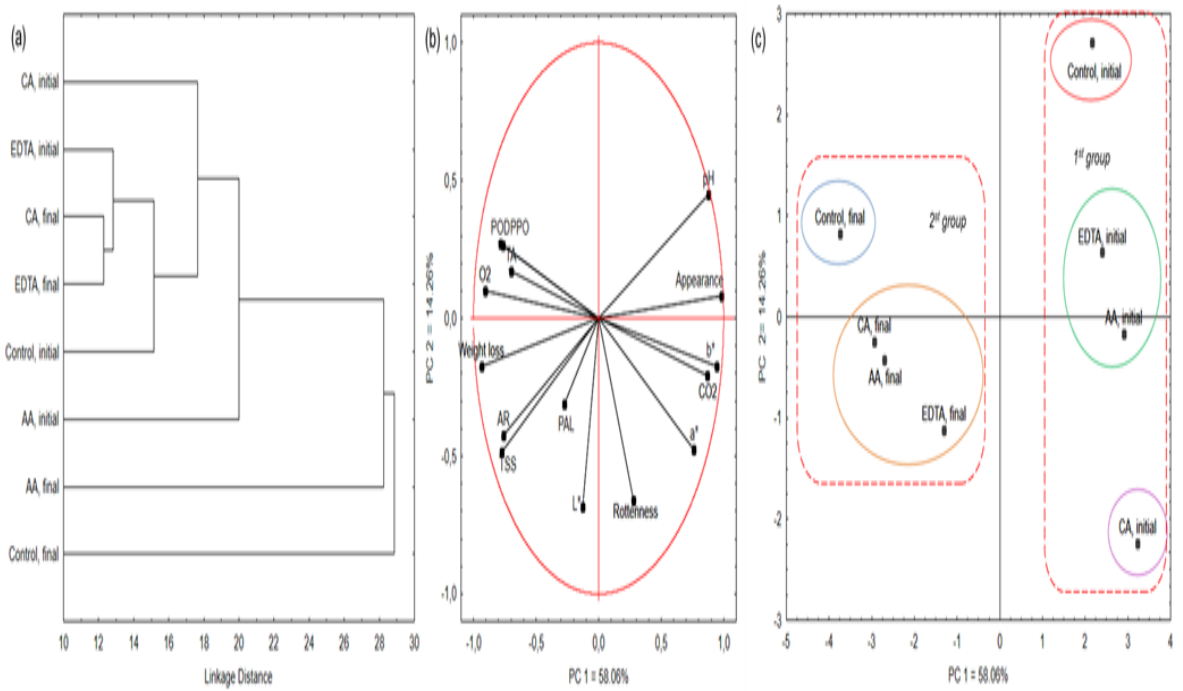

Figure 2. (a) Classification using cluster analysis (Eucledian distances); (b) Projection variable distribution for discrimination by PCA; and (c) Graphic projection of samples.

IECHo 2022

Conclusions

- This study evaluated the effect of antioxidant compounds in the preservation of minimally processed arracacha.
- The roots treated with this antioxidant showed lower weight loss, better visual grades, and lower rot rates. In addition, this treatment also led to the retention of PPO, POD, and PAL activity.
- Through multivariate analysis, the variables that characterized the beginning of the experiment were appearance and color parameters, while for the end of the storage PAL, weight loss, and sugars were responsible for the discrimination, indicating that the application of antioxidants affect the postharvest quality of minimally processed arracacha.
- Finally, from the results obtained, EDTA is the most indicated antioxidant to delay the browning reactions and increase the shelf life of minimally processed arracacha.

IECHo 2022

Thank you for your attention!

Antioxidants were efficient in reducing browning and increasing the shelf life in minimally processed arracacha (*Arracacia xanthorrhiza* Bancroft)

Aline Priscilla Gomes da Silva[1*], Jaqueline Visioni Tezotto-Uliana[2], Thais Helena de Araujo[3], William Gustavo Sganzerla[4], Ricardo Alfredo Kluge[5]

[1]Department of Biosystems and Agricultural Engineering, Michigan State University, 469 Wilson Road, East Lansing, MI 48824. E-mails: gomesdas@msu.edu, alinepgsilva@gmail.com

[2]College of Higher Education Santa Bárbara, Tatuí, São Paulo, Brazil. E-mail: jaqueline.tezotto@usp.br

[3]State University of Minas Gerais, Passos, Minas Gerais, Brazil. E-mail: thais.helena@uemg.br

[4]School of Food Engineering, University of Campinas (UNICAMP), Monteiro Lobato St., N.80, 13083-862, Campinas, São Paulo State, Brazil. E-mail: sganzerla.william@gmail.com

[5]Department of Biological Sciences, Escola Superior de Agricultura 'Luiz de Queiroz' – University of Sao Paulo, Pádua Dias 11, 13.418-900 Piracicaba, Sao Paulo, Brazil. E-mail: rakluge*@usp*.br
*Corresponding author: gomesdas@msu.edu, alinepgsilva@gmail.com