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# BIOTECHNOLOGICAL POTENTIAL OF APPLE POMACE AS A SOURCE OF PECTIN FOR FORMULATING FUNCTIONAL JUICES

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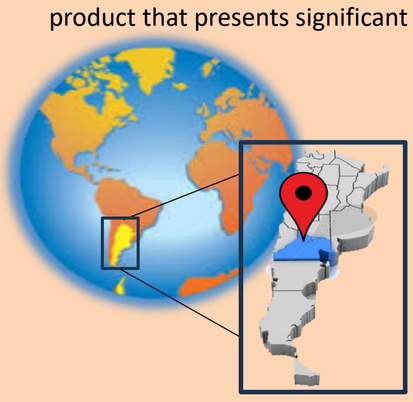
## INTRODUCTION & AIM

Apples are cultivated extensively worldwide, with Argentina's production primarily centered in the Alto Valle of Río Negro region. Processing these apples into concentrated juices, NFC (Not-From-Concentrate) juices, and ciders generates thousands of tons of pomace—a highly perishable by-product that presents significant environmental challenges.



However, apple pomace (AP) is a rich source of compounds with biotechnological potential, particularly pectin, recognized for its prebiotic properties, as it can serve as a substrate that promotes the growth and viability of lactic acid bacteria, enhancing their probiotic functionality and supporting the development of symbiotic formulations.

To efficiently recover these bioactive compounds while minimizing environmental impact, "green extraction" technologies have emerged as sustainable alternatives to conventional methods. These approaches reduce the formation of toxic residues and enhance the safety of the final extract.

**BIOTECHNOLOGICAL POTENTIAL** | **AIM** | **ENVIRONMENTAL CHALLENGES**

***To evaluate the effect of apple pomace pectin (APP) and commercial pectin (CP) on the viability of Lactiplantibacillus plantarum ATCC 8014 (LP) and Lacticaseibacillus casei ATCC 393 (LC) in Not-From-Concentrate (NFC) apple juice.***

## METHOD

### PECTIN EXTRACTION

**01** Apple pomace (AP) powder was used as the starting material (moisture content 2% and particle size <1000 µm).

**02** The (AP) powder was dissolved in a 1:30 ratio in water acidified to pH 2 using citric acid.

**03** The mixture was subjected to bath sonication for 25 min at 40 °C, followed by a thermal treatment for 70 min at 90 °C and 150 rpm.

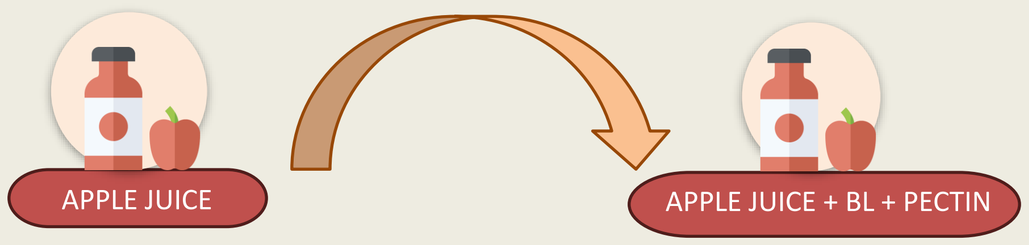
**04** The insoluble fraction was separated using a muslin cloth, and the supernatant, once cooled, was precipitated with alcohol.

**05** The extracted pectin was dried to constant weight and subsequently characterized by titration **(Table 1).** *(Owens et al., 1985; Putra et. al., 2023)*

### APPLE JUICE SUPPLEMENTED WITH PECTIN

Pectin extracted from AP and CP was dissolved in NFC apple juice at **1% (w/v).**

LC and LP were properly cultured and independently added to the NFC apple juice at a concentration of **7 log CFU/mL.**




Probiotic viability in the supplemented juices was monitored weekly by plate counting on MRS agar (37 °C for 48 h) over four weeks of refrigerated storage. The results were contrasted with those from controls without pectin supplementation.

## RESULTS & DISCUSSION

- The high **galacturonic acid content** indicates good extract quality. However, some inconsistency between the **degree of esterification** and the **methoxyl content** was observed, probably due to limitations in accurately determining the titration endpoint.
- However, in a separate assay (data not shown), the pectin demonstrated gelling ability in the presence of calcium ions, supporting its low degree of esterification and highlighting potential limitations of the analytical technique.
- Low-methoxyl pectins have demonstrated prebiotic properties and the ability to gel in the presence of calcium ions

**Table 1. Physicochemical parameters of the extracted pectin.**

| Parameters | Value |
|---|---|
| **Yield %** | 11,39 ± 1,16 |
| **Equivalent weight (g/eq)** | 195,0 ± 25,9 |
| **Methoxyl content %** | 12,48 ± 0,22 |
| **Degree of esterification %** | 46,29 ± 3,69 |
| **Galacturonic acid content %** | 153,1 ± 10,7 |

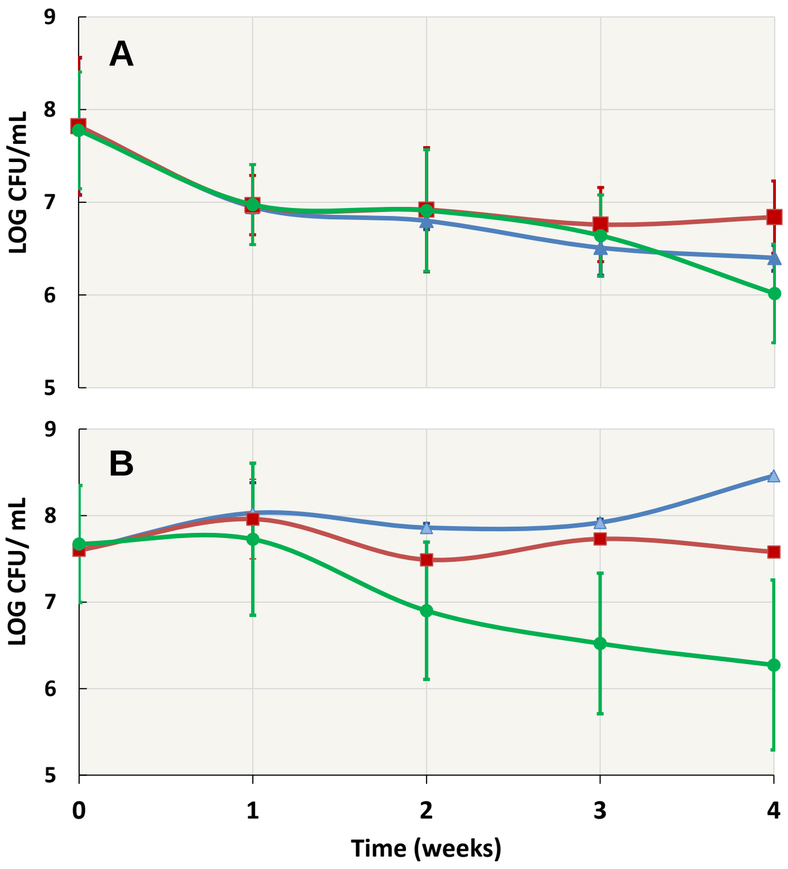



**Figure 1. Survival of lactic acid bacteria during refrigerated storage (4 °C) in NFC apple juices with A: *L. casei* (LC) and B: *L.plantarum* (LP) ( ● C: control, ▲ CP: commercial low-methoxyl pectin, and ■ APP: apple pomace–extracted pectin)**

- Probiotic survival was higher in the juices enriched with pectin than in the control juices (without pectin).
- In LC, the increases were smaller compared to the control, with rates of 5% and 10%, respectively, but APP proved more favorable than CP.
- This effect was more pronounced in LP, where the survival rate increased by 29% and 18% for CP and APP, respectively.

## CONCLUSION

- The obtained results are encouraging, suggesting a favorable symbiotic interaction between pectin and lactic acid bacteria within the tested matrix.
- Since *L. plantarum* and *L. casei* exhibited distinct behaviors, this reinforces that generalization is not possible and that each case should be evaluated individually.
- This study proposes an ecological and sustainable approach for obtaining functional ingredients (pectin) through green technologies, contributing to the reduction of environmental pollution.
- Although preliminary, these findings contribute to the continuous development of novel functional foods that promote human health while preserving the environment.
- Overall, this approach represents a promising and straightforward strategy to valorize large volumes of apple by-products, enriching both the dietary fiber content and the functional potential of fruit juices.

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