

# Enzymatic and Thermal Sugar Extraction Methods from Pear Pomace – lowering Sugar Levels and Modifying Sweetness

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## INTRODUCTION

Vegetable and fruit by-products represent 44% of global food waste by commodity. Pear pulps centrifugation for juice production results in a considerable amount of pomace (skins, seeds and flesh), mainly constituted of sugars, fibers, pectins, and other insoluble carbohydrates, minerals, organic acids and phenolic compounds. Several processes have been described to extract polysaccharides and oligosaccharides from fruit and vegetable by-products in recent years. Most of these are used for fermentation and production of bioethanol, and only a few are used as functional ingredients for application in the food, pharmaceutical, and cosmetic industries.

## OBJECTIVE



This work aims to obtain natural ingredients with sweetening power from pear pomace (skins, seeds and flesh).

It aims to evaluate the effect of hydrolysis conditions, namely enzyme concentration (XA), substrate/solvent ratio (XB), and duration (XC), on sugars obtained from pear pomace through four Box-Behnken Designs and determine the enzyme (Viscozyme® L or Pectinex® Ultra SP-L) and substrate state (fresh or 30 days frozen) optimal conditions to maximise the °Brix.

## METHODOLOGY

Enzymatic hydrolysis using citrate buffer was carried out to release the pear pomace sugars, followed by thermal hydrolysis using an autoclave. Upon hydrolysis, the supernatant residue was separated by centrifugation. The quantification of sugars in the liquid fraction was determined using a refractometer. Four experimental designs determined the hydrolysis conditions to be applied in each assay.

Factors	Levels		
	-1	0	1
XA (%)	0,5	1,75	3
XB (g/ml)	1/2	1/6	1/10
XC (h)	1	2,5	4

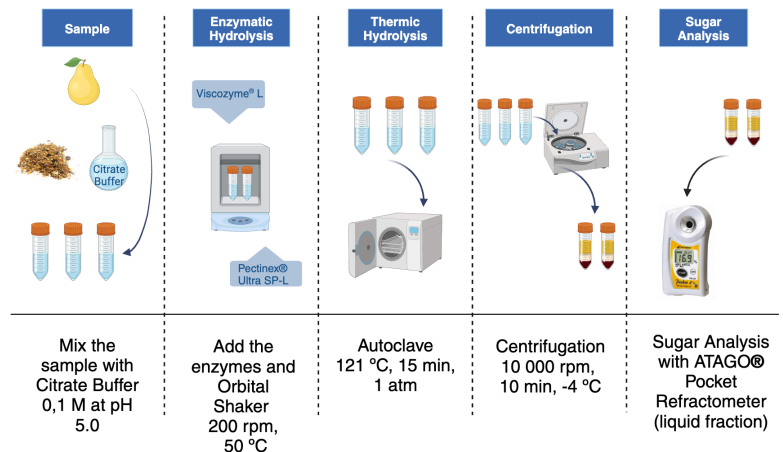
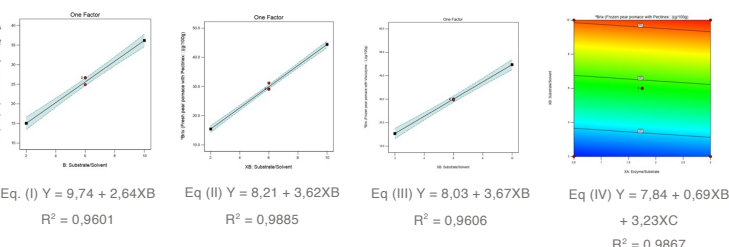
In the four Box-Behnken Designs, three independent factors, with 3-levels (-1,0,1) each, were considered: XA, XB, and XC, and 15 assays, including three repetitions of the central point, were performed. Box-Behnken's design of experiments and statistical analysis was resolved using Stat-Ease 360 Software.

Assays	Factor XA	Factor XB	Factor XC
1	-1	-1	0
2	1	-1	0
3	-1	1	0
4	1	1	0
5	-1	0	-1
6	1	0	-1
7	-1	0	1
8	1	0	1
9	0	-1	-1
10	0	1	-1
11	0	-1	1
12	0	1	1
13	0	0	0
14	0	0	0
15	0	0	0

## RESULTS

The results variance of the four experimental designs were well explained by a linear model (Eq (I), (II), (III) and (IV)), since it had statistical significance ( $p < 0.0001$ ) and a not significant lack of fit. Furthermore, the  $R^2$  and the predicted  $R^2$  indicated that the model explained >96% of the observed data and >94% of the predicted values.

	Lowest °Brix (g/100g)	Highest °Brix (g/100g)
(I) Fresh Pear pomace treated with Viscozyme® L	14,3 (Assay 1)	39,7 (Assay 10)
(II) Fresh Pear pomace treated with Pectinex® Ultra SP-L	14,9 (Assay 1)	46,8 (Assay 4)
(III) Frozen Pear pomace treated with Viscozyme® L	14,8 (Assay 1)	50,7 (Assay 3)
(IV) Frozen Pear pomace treated with Pectinex® Ultra SP-L	13,9 (Assay 1)	42,8 (Assay 10)



## CONCLUSION

Minimising food losses and waste within a circular economy framework has significant environmental benefits, such as reducing pollution and economic benefits, including the economic valorisation of by-products. This approach also aligns with the United Nations' Sustainable Development Goals. The extraction of sugars from pear pomace offers an effective and affordable way to integrate fruit by-products into various food products, contributing to the development of healthier products.

Statistical models developed in this study enabled evaluation of the impact of XA, XB, and XC on the °Brix obtained after hydrolysis processes. The °Brix was only affected by the substrate/solvent ratio (XB) in experimental designs I, II, and III. In experimental design IV, the enzyme concentration (XA) also impacted positively the °Brix.

Several other analyses, such as sugar identification and concentration, yield, and sweetness index, should be studied to identify the best conditions for obtaining the highest sugar concentration and to define the best hydrolysis conditions to get the best of pear pomace.

## ACKNOWLEDGMENT

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