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A biorefinery for integral valorisation of avocado peel and seeds through supercritical fluids.

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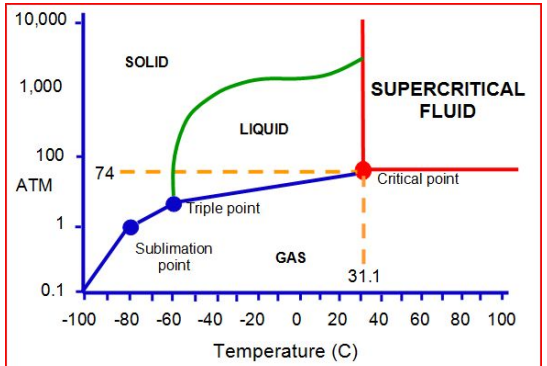

Content

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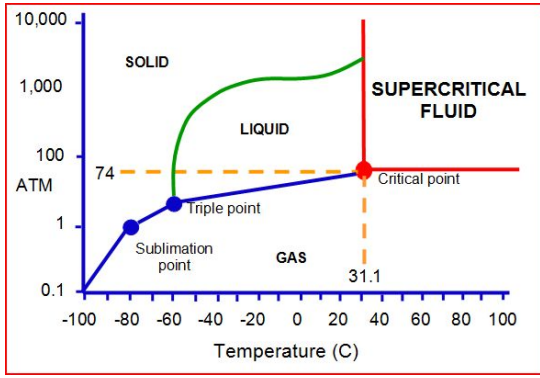


Introduction

What is the avocado?

Avocado is a tropical and subtropical fruit native to Mexico and Central America.

The pulp

It is rich in vitamins, minerals and especially monounsaturated fatty acids

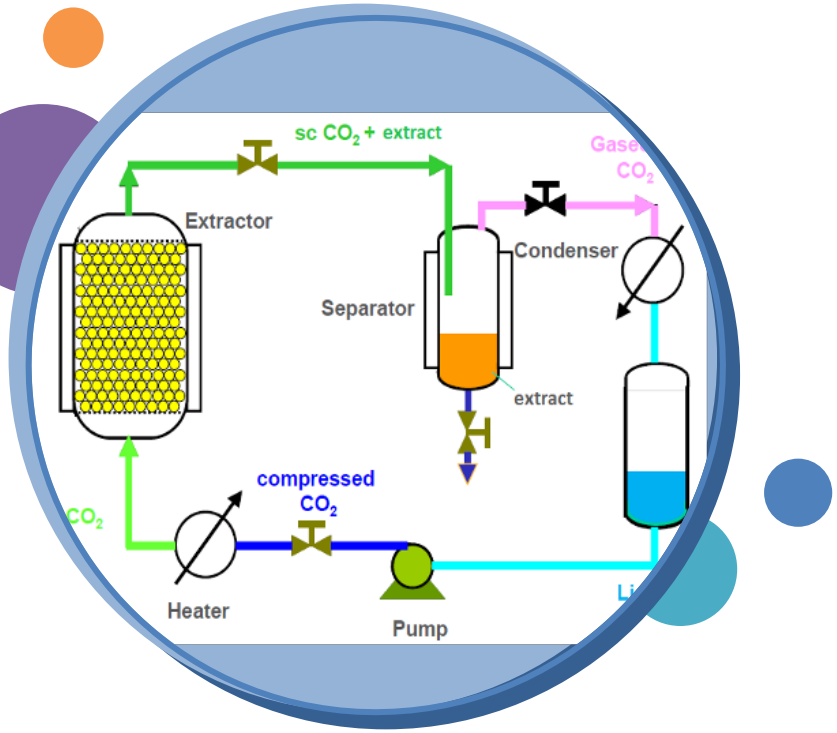
What does the consumption generate as residues?

- Seed
- Peel

Have the wastes any transformation potential?

Polyphenols, organic acids and flavonoids have been identified in these residues

Introduction



Advantages of supercritical fluids

- Lower operating temperaturas
- Improved yield
- Lower production cost
- Solvent power comparable to liquid solvents
- Very high volatility compared to the disolved substances
- High solvent free products

Introduction

"A biorefinery is a complex system, where biomass is integrally processed or fractionated 25 to obtain more than one product including bioenergy, biofuels, chemicals and high value-added compounds that only can be extracted from bio-based sources. The latter after a comprehensive study of the raw materials to be used and a sustainable design based on the latest state of the art technologies and approaches which include aspects of the three pillars of sustainability" (Moncada B et al., 2016)

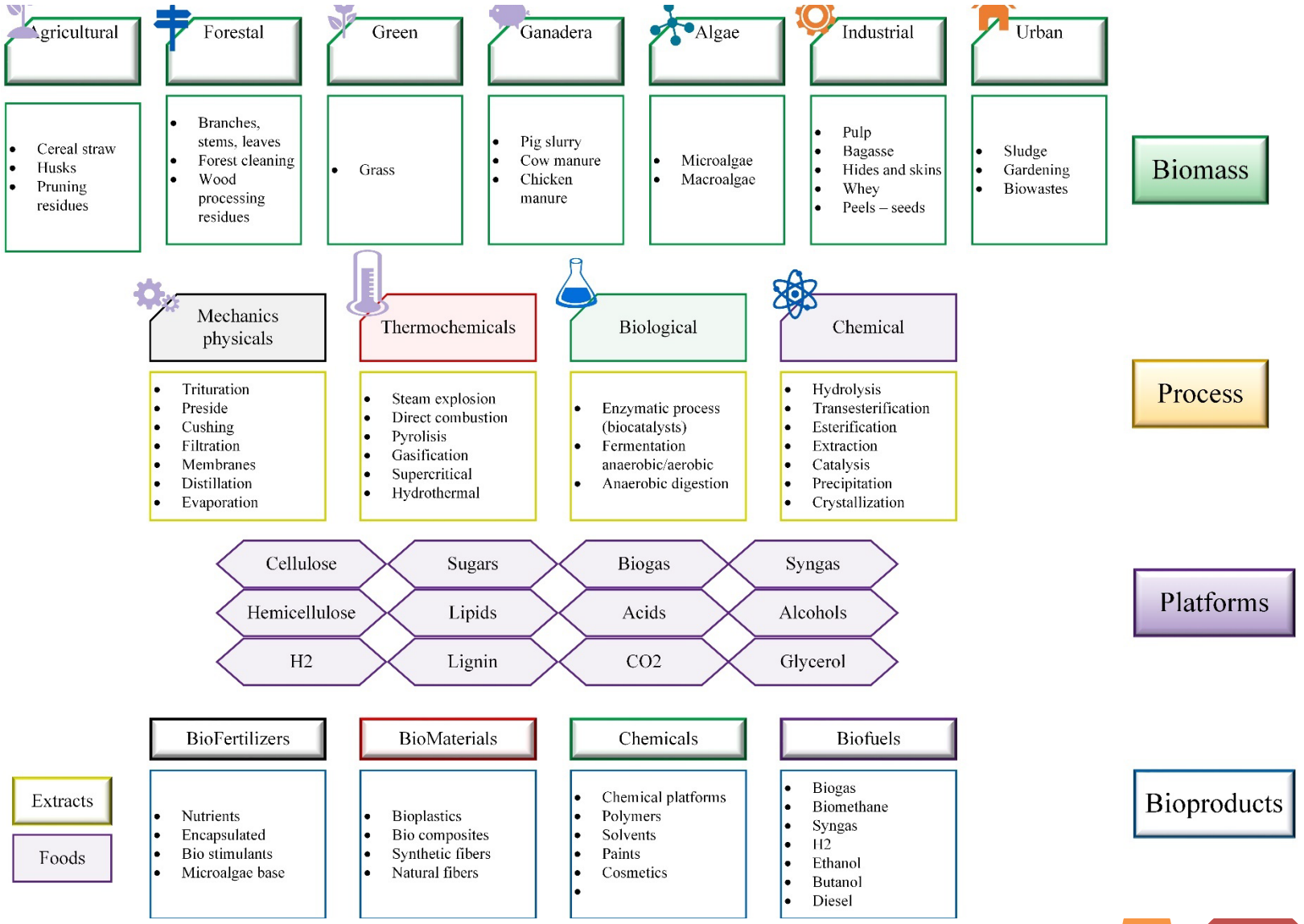


Figure 1. Scheme of the hierarchy in a biorefinery

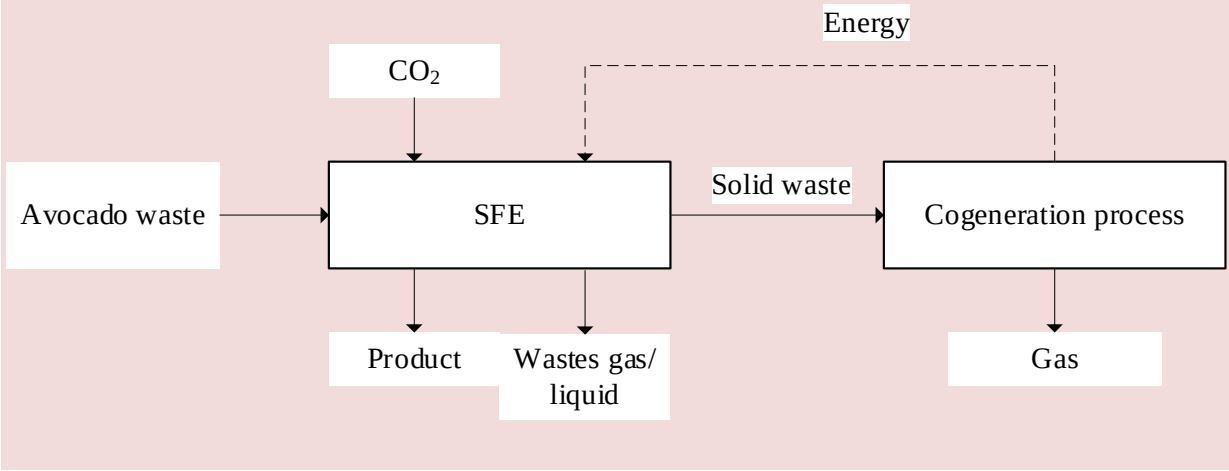
Methodology

Component	Peel [a]	Seed [a]
Moisture	7.33	7.02
Extractives	34.38	35.95
Cellulose	27.58	6.48
Hemicellulose	25.30	47.88
Lignin	4.37	1.79
Ash	1.04	0.87

a (Dávila et al., 2017)

Table 1. Avocado wastes composition

Figure 2. Processing scheme for the biorefinery based on the avocado wastes



Methodology

Table 2. Scenarios proposed for the use of the avocado wastes (peel and seed)

Raw material	Scenario	SFE	Cogeneration	Process type
Peel avocado	1	x		Stand-alone
	2	x	x	Biorefinery
Seed avocado	3	x		Stand-alone
	4	x	x	Biorefinery

Table 3. Aspects to evaluate in the work

Process assessment		
Technical • Yield • Energy production	Economic • Cost distribution • NPV • Minimum processing scale	Software • Aspen plus • Aspen Process Economic Analyzer

Results

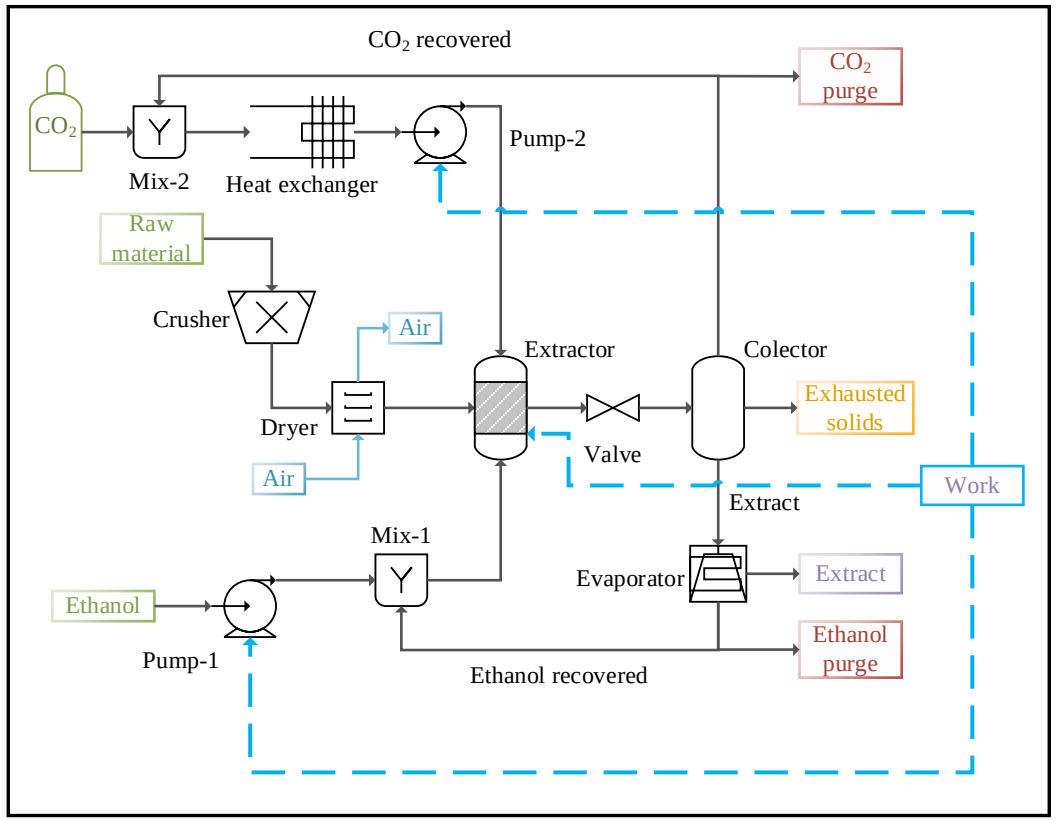


Figure 3. Flow diagram for integral biorefinery (SFE + cogeneration) for scenarios 2 and 4

Avocado peel	Avocado seed
• 1,256.71 kg/h • 0.22 kg extract/kg peel • 0.11 kWh	• 1,675.61 kg/h • 0.23 kg extract/kg seed • 0.10 kWh

Results

Table 4. Distribution of the cost for each scenario

Item	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Raw Materials	57.99	56.37	72.03	60.02
Utilities	3.07	5.75	1.28	6.74
Maintenance	9.18	8.93	6.17	7.87
Labor	1.18	1.15	1.10	0.92
Fixed & General	5.80	5.64	3.95	4.95
Plant Overhead	5.42	5.27	3.80	4.60
Capital Depreciation	17.37	16.90	11.67	14.90

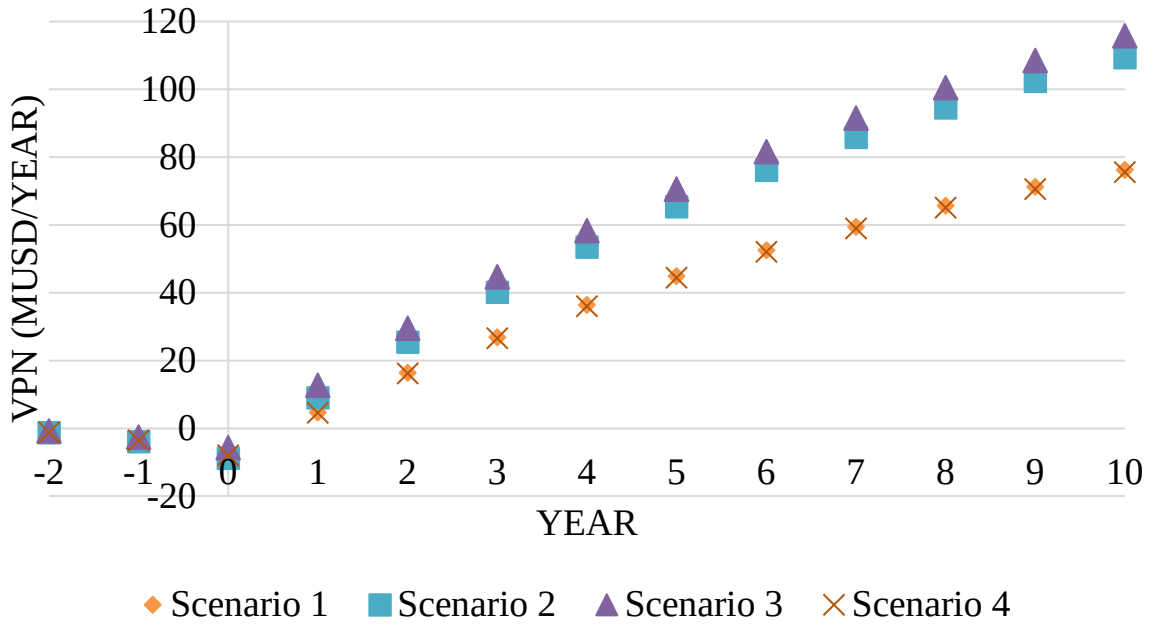


Figure 4. VPN obtained for each scenario analyzed

Table 5. Minimum processing scale

Scenario 1	• 18.6 kg/h avocado peel
Scenario 2	• 18.6 kg/h avocado peel
Scenario 3	• 8.29 kg/h avocado seed
Scenario 4	• 15.92 kg/h avocado seed

Conclusion

Avocado wastes are potentital raw materials for SFE process and biorefineries based on SFE

Avocado residues are projected as promising raw materials for obtaining bioactive compounds employing supercritical fluid extraction processes. However, this process generates an exhausted solid with a high potential for transformation, e.g., cogeneration processes. The implementation of an additional processing step uses the valorization concept through biorefineries. This concept provides better results than those obtained in stand-alone processes (only extraction stage with supercritical fluids). The use of the residues obtained in the initial stages of the process allows advancing in integral biorefineries. The integral biorefineries based on extraction with supercritical fluids and cogeneration allow the integral utilization of avocado residues (peel and seed).

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