Avocado-derived biomass: Chemical composition and antioxidant potential

Minerva C. García Vargas, María del Mar Contreras, Irene Gómez-Cruz, Juan Miguel Romero-García, Eulogio Castro

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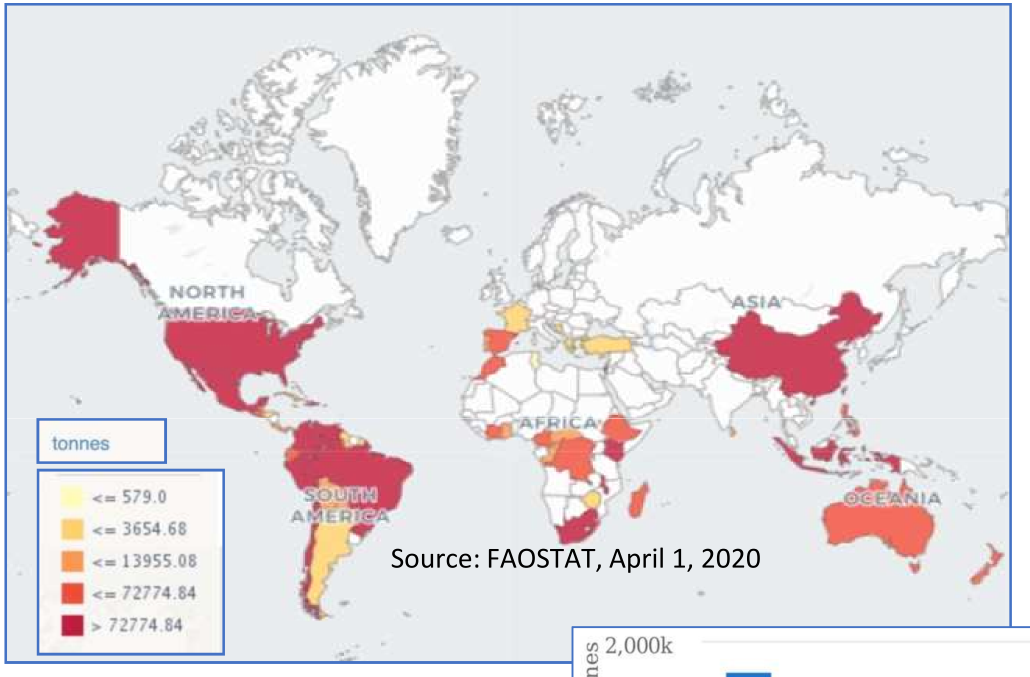
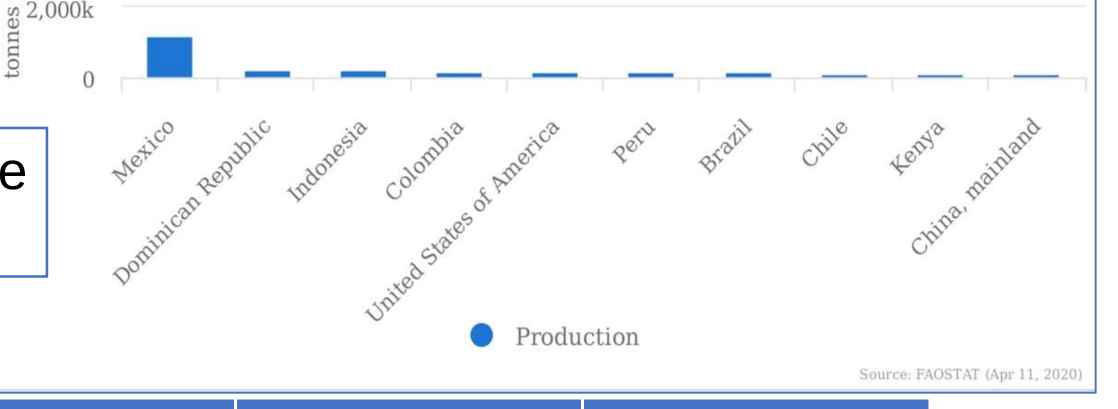
Production quantities of avocados by country



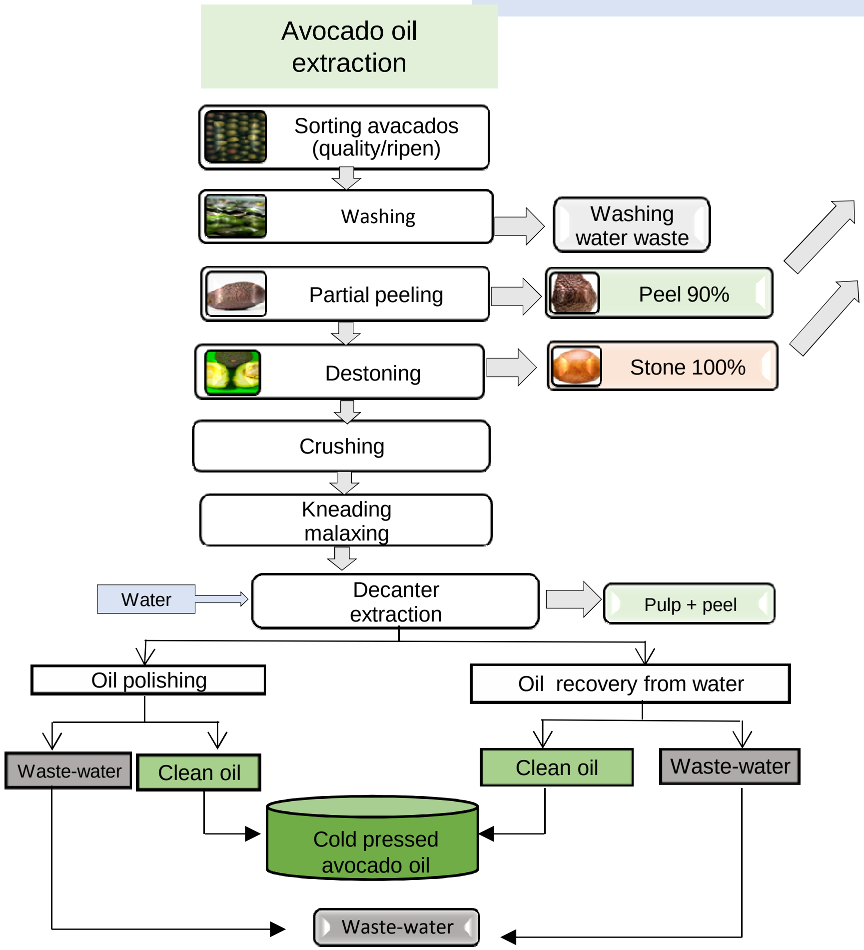
Source: FAOSTAT, April 1, 2020

Production quantities of avocados by country, average 1994 - 2018

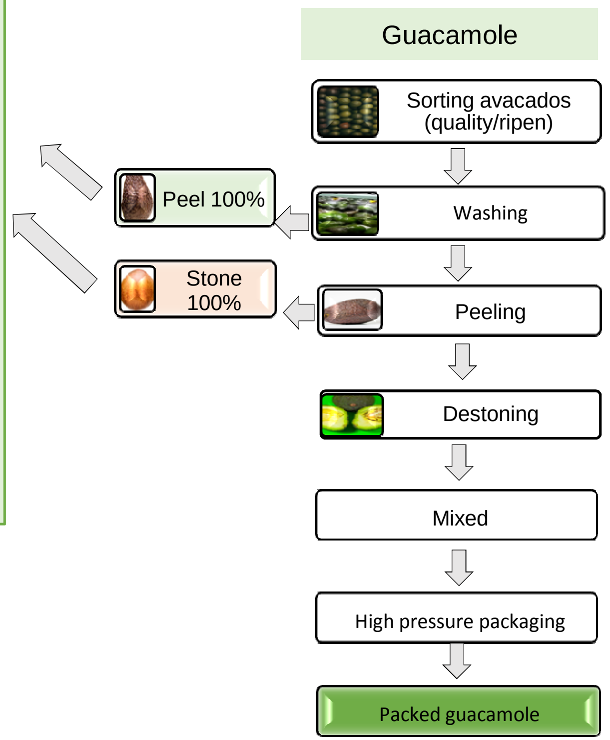
Top 10 producers average 1994-2018



Avocado can be better exploited



Avocado can be better exploited if the residual parts are used as alternative source of value-added compounds from the structural and non-structural chemical fraction



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Objective

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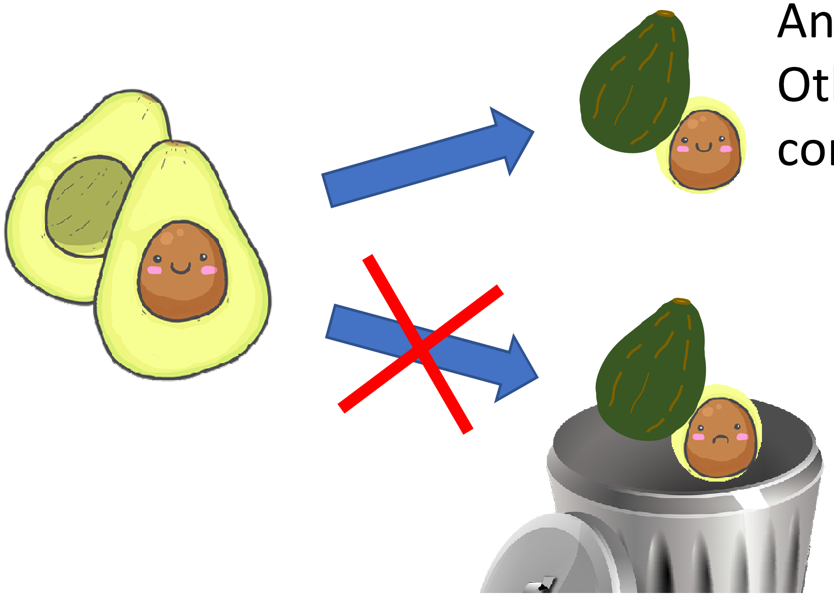
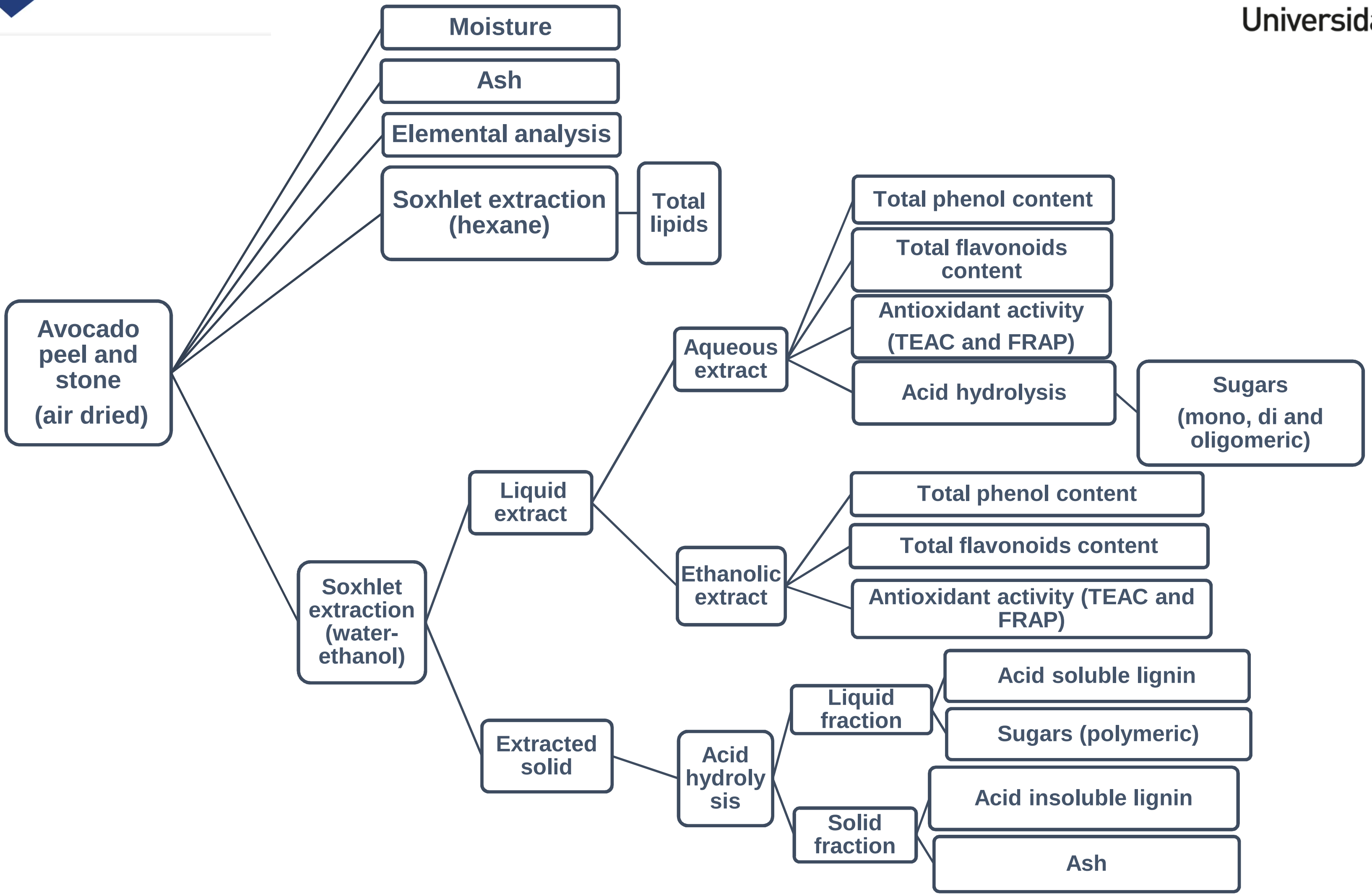
In this work, to enable a complete valorization of avocado peel and stone in multiple bioproducts, the chemical composition was determined, as well as their phenolic content and antioxidant activity were studied using food grade solvents.



Antioxidants
Other valuable chemical components

Methods


Avocado peel and stone (air dried)
Moisture
Ash
Elemental analysis
Soxhlet extraction (hexane)
Total lipids
Soxhlet extraction (water-ethanol)
Liquid extract
Aqueous extract
Total phenol content
Total flavonoids content
Antioxidant activity (TEAC and FRAP)
Acid hydrolysis
Sugars (mono, di and oligomeric)
Ethanolic extract
Total phenol content
Total flavonoids content
Antioxidant activity (TEAC and FRAP)
Extracted solid
Acid hydrolysis
Liquid fraction
Acid soluble lignin
Sugars (polymeric)
Solid fraction
Acid insoluble lignin
Ash

Methods

- Avocado peel and stone (air dried)
  - Moisture
  - Ash
  - Elemental analysis
  - Soxhlet extraction (hexane)
    - Total lipids
  - Soxhlet extraction (water-ethanol)
    - Liquid extract
      - Aqueous extract
        - Total phenol content
        - Total flavonoids content
        - Antioxidant activity (TEAC and FRAP)
        - Acid hydrolysis
          - Sugars (mono, di and oligomeric)
      - Ethanolic extract
        - Total phenol content
        - Total flavonoids content
        - Antioxidant activity (TEAC and FRAP)
    - Extracted solid
      - Acid hydrolysis
        - Liquid fraction
          - Acid soluble lignin
          - Sugars (polymeric)
        - Solid fraction
          - Acid insoluble lignin
          - Ash

Moisture and ash were determined by gravimetric analysis.
Hydrogen, Carbon, Nitrogen and Sulfur were determined by elemental analysis.

Total phenolic and flavonoid content were measured using the Folin-Ciocalteu colorimetric assay and the aluminum chloride colorimetric methods, respectively.

Acid hydrolysis let measure sugars by high-performance liquid chromatography (HPLC)

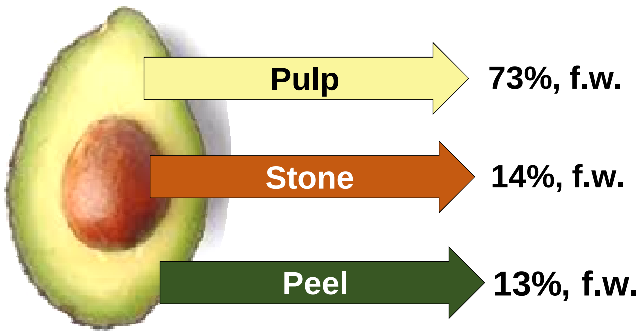
Antioxidant activity was appraise by the ability to scavenge cation ABTS$\bullet^+$ and Fe^{2+} using the Trolox equivalent antioxidant capacity (TEAC) and ferric ion reducing antioxidant power (FRAP)

Acid soluble lignin was determined by spectrophotometry at 205 nm

Acid insoluble lignin was determined by gravimetric analysis after a two-step acid hydrolysis of the extracted solid from the Soxhlet extraction

Biomass was firstly extracted with water using Soxhlet extraction and secondly with ethanol to obtain two liquid fractions (aqueous and ethanolic extracts) and a solid fraction

Characteristics and elemental composition

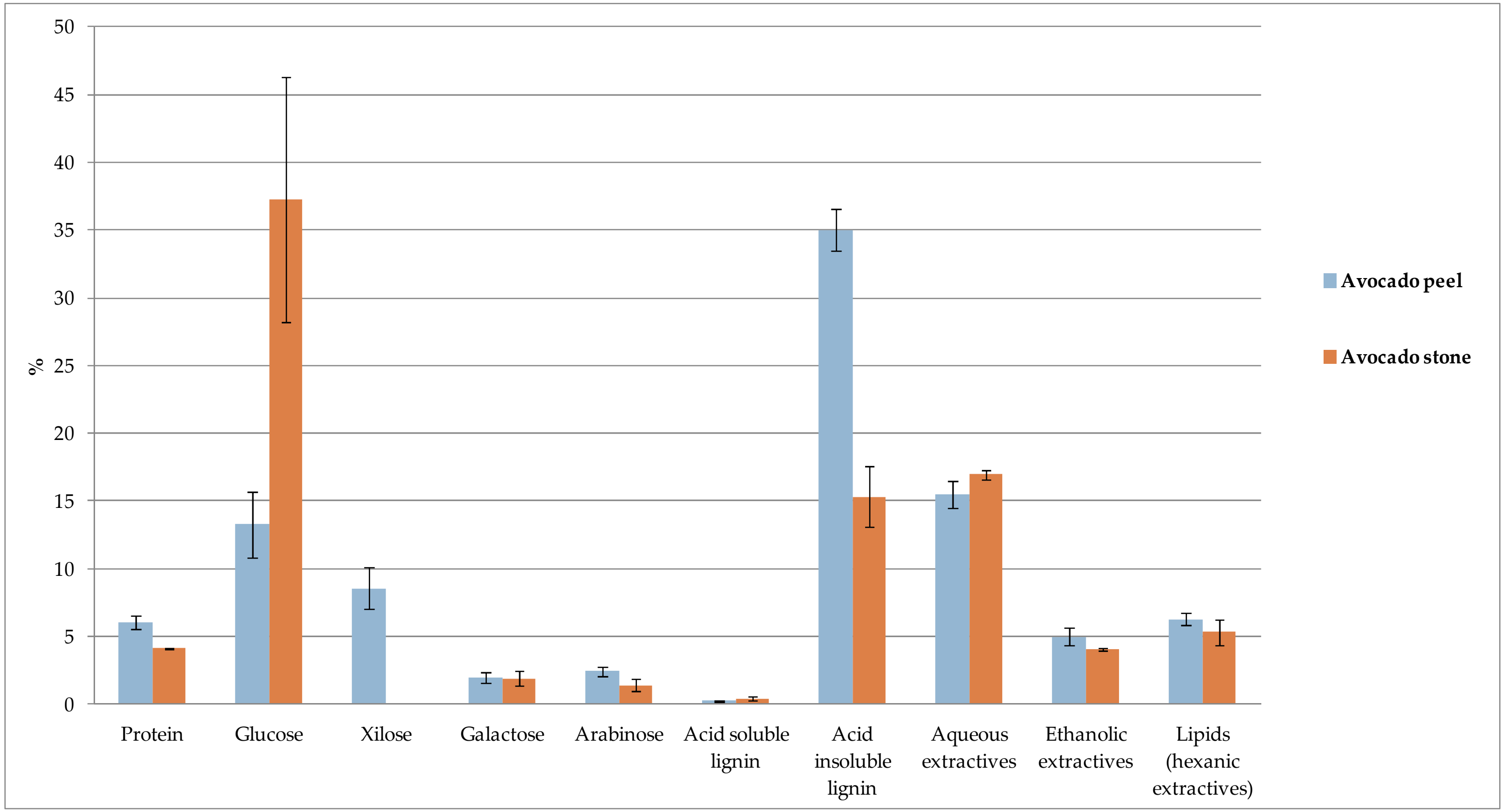


Element %	Peel	Stone	Element %	Peel	Stone
N	0.97 ± 0.07	0.66 ± 0.01	H	5.71 ± 0.02	5.58 ± 0.02
C	49.83 ± 0.42	42.05 ± 0.05	O	42.2 ± 2.62	50.79 ± 1.56
Ash	3.81 ± 0.05	2.76 ± 0.28	Humidity	70.9± 0.2	52.0 ± 0.4

•Avocado peel and stone presented similar elemental composition, but peel contained slightly higher percentages of N and O.

•For its use as biofuel for domestic or industrial heating, some limitations are the ash content and the humidity compared to other biomasses, especially, for peel.

Chemical Characterization



Valorization of lignin and sugars from the structural fraction is of interest given the high content, which could be used to obtain biofuels, such as ethanol and buthanol, or derivatives with industrial relevance.

Total phenolic (TPC) and flavonoid content (TFC) and Antioxidant activity

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Part	TPC		TFC		TEAC		FRAP	
	AE	EE	AE	EE	AE	EE	AE	EE
In terms of biomass weight (g GAE or g rutin or mmol TE/100 g, d.w.)								
AP	4.13 ±0.56	0.60 ±0.12	5.35 ±1.36	0.75 ±0.09	17.48 ±3.12	0.47 ±0.05	15.20 ±2.02	1.49 ±0.34
AS	0.31 ±0.06	0.18 ±0.03	0.45 ±0.13	0.67 ±0.02	1.66 ±0.31	0.32 ±0.08	1.29 ±0.32	0.66 ±0.05
In terms of extract weight (g GAE or g rutin or mmol TE/100 g, d.w.)								
AP	26.56 ±2.77	12.60 ±3.17	34.23 ±6.90	15.63 ±1.25	112.15 ±13.35	9.67 ±2.11	97.78 ±7.83	37.77 ±1.68
AS	1.81 ±0.34	4.39 ±0.88	2.66 ±0.82	16.49 ±0.80	9.85 ±2.03	7.84 ±2.04	7.71 ±1.93	16.31 ±1.62

AE, aqueous extract; AP, avocado peel; AS, avocado stone; EE, ethanolic extract; GAE, gallic acid equivalents; TE, trolox equivalents.

Total phenolic content (TPC); Total flavonoids content (TFC) and Antioxidant Activity determined by TEAC and FRAP assays

- The extractive fraction of the peels contained the highest amount of phenolic compounds (4.7 g/100 g biomass), mainly, concentrated in the aqueous fraction (i.e. 87%) compared to the ethanol one, which was subsequently extracted.
- It correlated with a major antioxidant activity.

Conclusions

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- Avocado peel and stone have a high potential to obtain various valuable compounds from their chemical composition in a biorefinery context.

- Stone is rich in glucose from the polymeric fraction and peel in lignin.

- Peel is a rich source of antioxidants.

- This could generate an extra income before, for example, burning or disposal with no industrial benefits.

Acknowledgments

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Some of the components in Figures are made with the help of images by Pixabay.

Thank you for your attention

“Somewhere, something incredible is waiting to be known.”
— Carl Sagan

Minerva C. García Vargas[1;#,*], María del Mar Contreras[2,#,*], Irene Gómez-Cruz[2], Juan Miguel Romero-García[2], Eulogio Castro[2]

[1] Tecnológico Nacional de México / Instituto Tecnológico de Zitácuaro; minerva.gv@zitacuaro.tecnm.mx (M.C.G.V.)
[2] Department of Chemical, Environmental and Materials Engineering, Universidad de Jaén, Jaén, Spain; mcgamez@ujaen.es (M.D.M.C.); igcruz@ujaen.es (I.G.-C.); jrgarcia@ujaen.es (J.M.R.G); ecastro@ujaen.es (E.C.G)