Avocado-derived biomass: Chemical composition and antioxidant potential

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Production quantities of avocados by country

Top 10 producers average 1994-2018

Source: FAOSTAT, April 1, 2020

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Production quantities of avocados by country, average 1994 - 2018
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.
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.
Methods

Avocado peel and stone (air dried)

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

Introduction | Methods | Results | Conclusions
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.

Methods

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$^{•+}$ and Fe$^{2+}$ using the Trolox equivalent antioxidant capacity (TEAC) and ferric ion reducing antioxidant power (FRAP).

Acid insoluble lignin was determined by gravimetric analysis after a two-step acid hydrolysis of the extracted solid from the Soxhlet extraction.
## Characteristics and elemental composition

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.

### Results

| Element | Peel (f.w.) | Stone (f.w.) | Element | Peel (f.w.) | Stone (f.w.) |
|---------|-------------|--------------|---------|-------------|--------------|
| 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   |
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 butanol, or derivatives with industrial relevance.
Total phenolic (TPC) and flavonoid content (TFC) and Antioxidant activity

| Part   | TPC       | TFC       | TEAC      | FRAP      |
|--------|-----------|-----------|-----------|-----------|
|        | AE        | EE        | AE        | EE        | AE        | EE        | AE        | EE        |
| 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 biomass weight (g GAE or g rutin or mmol TE/100 g, d.w.)

| Part   | TPC       | TFC       | TEAC      | FRAP      |
|--------|-----------|-----------|-----------|-----------|
|        | AE        | EE        | AE        | EE        | AE        | EE        | AE        | EE        |
| 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.

• 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

• 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.
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Thank you for your attention

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

— Carl Sagan

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