Maestría en Ingeniería en Diseño de Bioprocesos

Title

Utilization of coffee waste from Puebla and Chiapas to obtain antioxidants and antimicrobial

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UTILIZATION OF COFFEE WASTE FROM PUEBLA AND CHIAPAS TO OBTAIN ANTIOXIDANTS AND ANTIMICROBIAL

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1. Introduction

Chiapas and Puebla are the main producers of coffee cherries in México with 39.8% and 15.2% of annual production respectively (SIAP-SAGARPA, 2013). However, during the process of coffee some byproducts such as tons of pulp, mucilage and coffee shells are also generated and considered as waste. Most of them are thrown into landfills and not recycled for other purposes. The organic matter of this waste makes highly polluting because requires a high oxygen demand for its degradation (Beyene and col. 2012).

However coffee pulp is essentially rich in sugar, proteins, minerals, caffeine and polyphenols of industrial importance (for example: chlorogenic, caffeic and ferulic acids). Furthermore, the use of phenolic antioxidant compounds as food additives is one of the most efficient ways to reduce rancidity, minimize the production of toxic molecules oxidation and extend the shelf life. Proper extraction of these compounds would give a value to the waste generated during the process of coffee (Bonilla and col., 2014).

This work contributes to use of waste coffee, taking advantage of its potential antioxidant properties of extracts for applying in food or in other industrial sectors.

2. Aim

- Characterize coffee residues with proximal analysis.
- Improve conditions for extraction of antioxidants and antimicrobials from coffee wastes by factorial designs.
- Evaluate the antimicrobial and antioxidant capacity of the extracts.

3. Method

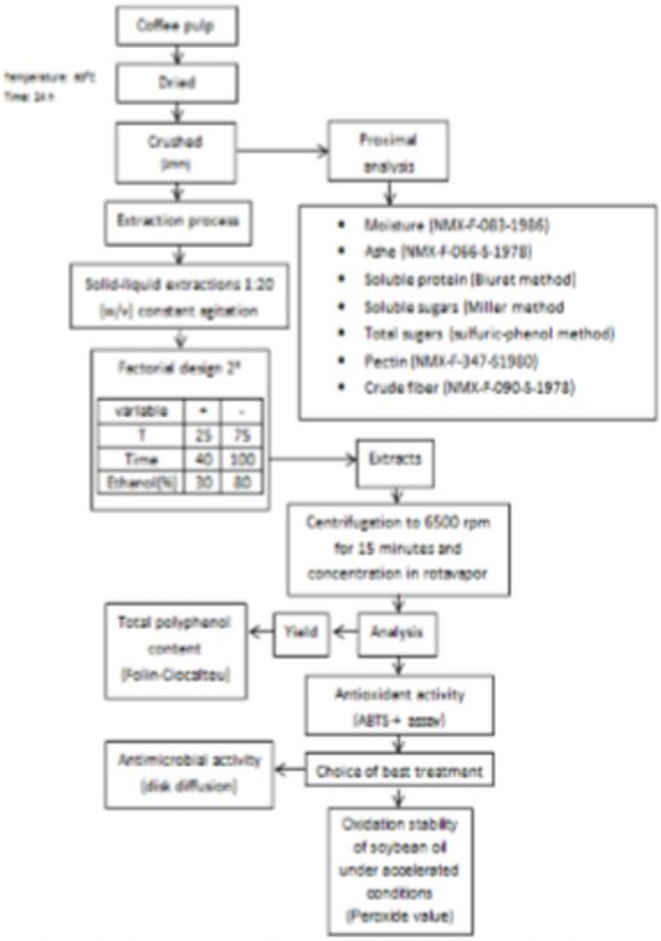

Fig. 1. Extraction procedure used to obtain the crude extracts containing phenolic compounds.

4. Results

Table 1 shows the average chemical composition with standard deviation of coffee residue from Zapotitlán, Puebla; Villaflores and Oxchuc, Chiapas. The results are expressed as percentage of dry weight.

Table 1. Characterization of coffee waste of different regions.

Characteristics	Zapotitlán, Puebla	Oxchuc, Chiapas*	Villaflores , Chiapas**
Moisture (%)	84.40±0.27	19.30±0.36	11.99±0.28
Ash(%)	1.21±0.05	1.69±0.24	1.59±0.19
Reducing sugars (%)	5.79±0.0	2.55±0.0	6.06±0.11
Total sugars (%)	9.27±0.48	3.38±0.48	8.28±0.46
Soluble proteins (%)	26.23±0.75	25.37±1.75	21.75±1.32
Pectin (%)	1.82±0.21	1.73±0.17	1.96±0.06
Crude fiber (%)	23.57±0.71	20.07±0.23	17.22±0.74

*Wet waste **Dry waste

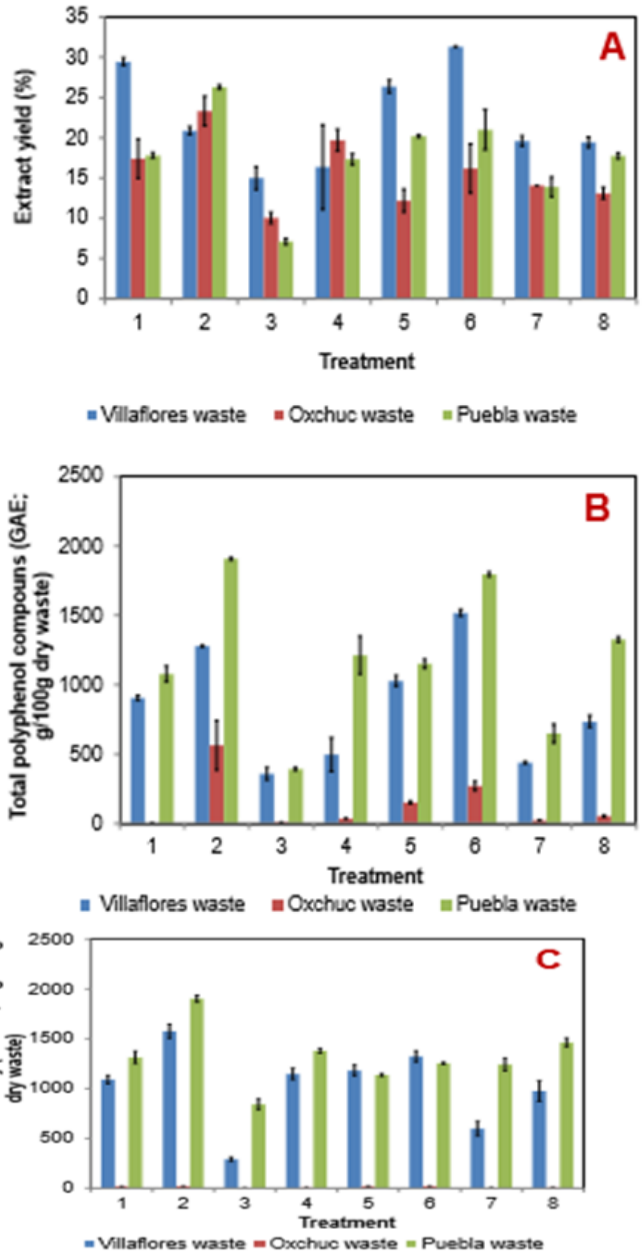

Figure 2. Results of treatments in factorial design: A) Extract yields, B) total polyphenol content and C) antioxidant activity.

Table 2 Main effects in factorial design 2^3.about the extract yield, total polyphenolics content and antioxidant activity.

Sample of coffee waste	Response	Content	Extraction conditions	Significant factors
Villaflores, Chiapas	Extract (%)	31.3 ± 0.070	75°C, 30% EtOH, 100 min	EtOH t
	Total Polyphenol (GAE;mg/100g waste)	1519.13 ± 23.93	75°C, 30% EtOH, 100 min	T EtOH
	Antioxidant activity (VCEAC;mg/100g waste)	1577.18 ± 70.94	75°C, 30% EtOH, 100 min	T EtOH
Oxchuc, Chiapas	Extract (%)	23.3 ± 1.83	75°C, 30% EtOH, 40 min	T EtOH
	Total polyphenol GAE;mg/100g waste)	563.74 ± 179.17	75°C, 30% EtOH, 100 min	T EtOH
	Antioxidant activity (VCEAC;mg/100g waste)	20.46 ± 0.20	75°C, 30% EtOH, 100 min	T EOH
Zapotitlán, Puebla	Extract (%)	26.30 ±0.25	75°C, 30% EtOh, 40 min	T EtOH
	Total polyphenol GAE;mg/100g waste)	1908.42 ± 8.94	75°C, 30% EtOH, 100 min	T EtOH
	Antioxidant activity (VCEAC;mg/100g waste)	1904.27 ± 34.30	75°C, 30% EtOH, 100 min	T EtOH

T: temperature; EtOH:etanol; VCEAC: Vitamin C equivalent antioxidant capacity , GAE: Galic acid quivalent.

Table 2 presents the best responses (yield extract, TP and AA) in the factorial design 2^3 and the main effects of extraction with a significance level of $p < 0.05$. According to statistical analysis, the temperature and the ethanol concentration are the most representative effects for obtaining high antioxidant activity in extracts.

Regarding the Peroxide inhibition, calculated with Ec. (1), the best treatments for each sample were 22.35±0.74%, 7.20±1.60% y 24.29 ±1.52% for Villaflores, Oxchuc and Zapotitlán coffee waste extracts.

$$\%\ peroxide\ inhibition = \left(1 - \frac{PV\ sample}{PV\ control}\right) x\ 100 \quad \text{Ec. (1)}$$

5. Conclusion

In this study was carried out an experimental design to look the effect of three variables (time, temperature and ethanol concentration) on antioxidant extraction from coffee pulp waste. In general, increased temperature and decreased ethanol concentration enhanced the antioxidant activity. The time is not a significant factor to improve the antioxidant activity. CW ethanolic extracts were able to stabilize soybean oil under accelerated oxidation conditions, minimizing PV.

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