

THEVETIA PERUVIANA

Extraction and Characterization of Oil from Thevetia Peruviana Using Supercritical CO₂

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ABSTRACT

Thevetia peruviana is an always green tree that grows well at adverse condition and it is well adapted to Yucatan weather. Its kernel contains more than 60 % of oil. Because the toxicity of the plant the oil is non edible and then a good candidate for biofuel production. In this study it is reported the results of supercritical extraction of oil from Thevetia peruviana kernels. The yield obtained 70 % is higher than that obtained using solvent extraction 62 % with petroleum ether, 60 % with n-hexane, and to 40 % using mechanical extraction.

INTRODUCTION

Thevetia peruviana, Cerbera peruviana Pers. or Thevetia herifolia Juss, also known as Cascabel and azucena is a plant of rapid grow very resistant to adverse conditions; grow well in tropical areas and it is found from U. S. A. to Argentina, specially at Mexico, Brazil and West Indians. Is an always green tree with a rounded fruit product that first is green and then turned black.



Figure 1. Thevetia peruviana tree, flower, fruit, peel and kernel

According to Sahoo et al [1] Thevetia peruviana is a fruit-harvest almost throughout the year. All the parts of thevetia peruviana are toxic due to cardenolic compounds and cianhidric acid. Then this non-edible oil is an excellent source for bio-fuel. Ibiyemi et al [2] report that the kernel has more than 62 % oil and are good prospect for biodiesel production. Obasi et al [3] reports variations in oil content from 45 to 72 % according with the season. The extraction methods reported include mechanical extraction and solvent extraction. In this study we present results of supercritical extraction of thevetia peruviana oil using CO₂ at pressure and temperature used for *Jatropha curcas*.

MATERIALS AND METHODS

Seeds

The fruit of *Thevetia peruviana* used was growth at Yucatan peninsula in Mexico. When received the seeds has 2% humidity and it was not necessary to dry.

Because the high oil content the use of an electric mill was difficult. Instead a knife was used to open the nut, get the kernel and cut it in small pieces that were passed for several sieves providing an average diameter of 1.14 mm (0.0449 inches).

Figure 2 show that kernels form the 29 % of the total mass of the nut.

	weight (g)	%	
Peel 1	3,2743	68%	
Peel 2 Membrane	.0926	2%	
Seed with peel	5.0125	100%	
Kernel	1,4005	29%	

Figure 2. Parts of *Thevetia Peruviana* seeds

Gases of operation
Industrial grade CO₂ with a purity of 99.9 % and dry air were supplied by Praxair, Merida-Mexico.

Supercritical extraction

Figure 3 shows a photograph of the experimental device. It is a 0.1 liter cell which is charged with 20 grams of powder of *Thevetia peruviana*. Each run has 10 minutes of static extraction and 30 minutes of dynamic extraction with a CO₂ flow rate of 1.8 g/min.



Figure 3. Extraction system SFT-150 by Supercritical Fluid Technology Inc. Newark, U.S.A.

Experimental conditions

Because we did not found any report of supercritical extraction with CO₂ for *Thevetia peruviana* seeds, we used Wei-Heng et al [4] parameters recommended for supercritical extraction of *Jatropha Curcas*. Pressures of 250 to 350 bar, and temperatures of 40 to 60 °C, but tested also 80 °C.

Fatty acid analysis

From each extraction we take 0.05 grams of oleoresin to be used in Gas chromatography / Mass spectrometry using the procedure of saponification and derivation recommended by Damiani et al [5].

The equipment used was an Agilent chromatograph 6890 N and Mass spectrograph Agilent 5973 e. The derivatized samples were injected (ml) with a ratio split 50:1 into a column Agilent HP-5 GC 5%-phenyl-methylpolysiloxano, 30 m x 0.32 mm I.D., 0.25 µm. The carrier gas is He at volumetric flow rate of 1.1 ml min⁻¹. Temperature was increased 25 °C min⁻¹ from 140 to 190 °C, after 1 min it was increased to 240 °C at 4 °C min⁻¹ and keeps constant for 15 min.

RESULTS

The oil yield is defined as:

$$\text{yield} = \frac{\text{grams of extracted oil}}{\text{grams of seeds charged in cell}}$$

The results obtained for the extraction of *Thevetia peruviana* oil are shown in Figure 4. It is observed that at the temperature of 40 °C increasing the pressure from 250 to 300 and 350 bar more than duplicate the yield.

A kinetic run was done at the best conditions: P=350 bar and T=80 °C. The result is shown in Figure 5 and provide information that total oil extraction get 70 % of the seeds charged to the extraction cell and that a time of 30 hours are needed for that extraction.

Fatty acids found in *Thevetia peruviana* oil.

Table 1 presents the content of some fatty acids in the extracted oil and compare it with data of Obasi [3]. It is observed that oleic acid, palmitic acid, and stearic acid are main fatty acids present.

Fatty acid	SC-CO ₂ extract	Obasi et al [3] averaged
C16:0	17.59	25.78
C18:0	12.19	10.39
C18:1	65.51	41.86

Table 1. Relative ratio composition of three important fatty acids in *Thevetia peruviana* seed oil

CONCLUSIONS

The extraction of oil from *Thevetia peruviana* seeds may be carried out by several methods. Figure 6 show the yield of four.

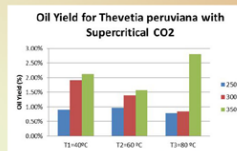


Figure 4. Oil yield at different pressure and temperature, with 0.5 hr of extraction time

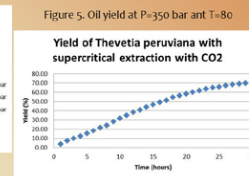


Figure 5. Oil yield at P=350 bar and T=80

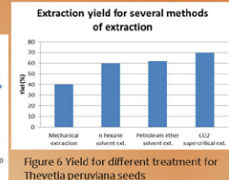


Figure 6. Yield for different treatment for *Thevetia peruviana* seeds

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