

Short communication

Fatty acid profiles of species of *Jatropha curcas* L., *Jatropha mollissima* (Pohl) Baill. and *Jatropha gossypifolia* L.



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ABSTRACT

The purpose of this study was to determine a standard of fatty acids from species of *Jatropha curcas* L., *Jatropha mollissima* (Pohl) Baill., and *Jatropha gossypifolia* L. The sample set consisted of 11 samples with three repetitions for each species, resulting in a total of 99 samples. Matrix of fatty acid data, principal component analyses (PCA) techniques and hierarchical cluster analyses (HCA) were applied in order to verify the similarity and discrimination of the samples for fatty acid profile. The PC1 (*x*-axis) discriminates against samples of *J. curcas*, *J. mollissima* and *J. gossypifolia* while these latter two species are discriminated in PC2 (*y*-axis). In the HCA, the dendrogram also shows the separation of the three species as was observed during the PCA. The major variations in this separation were oleic (C18:1), linoleic (C18:2), stearic (C18:0) and palmitic (C16:0) acids. In both *J. mollissima* and *J. gossypifolia* there is a predominance of linoleic acid (C18:2), whereas for *J. curcas* there is a balance on the equivalent proportion of oleic (C18:1) and linoleic (C18:2) acids. Oleic (C18:1) and linoleic (C18:2) acids sum constitute a mean of 76.5%, 78.5%, 84.5% of the total sample composition of *J. curcas*, *J. mollissima* and *J. gossypifolia*, respectively. For the studied species of *Jatropha*, the mean oil content was 35.0% for *J. curcas*, 18.3% for *J. mollissima* and 22.1 % for *J. gossypifolia*. The difference between the oil content in the species comes from the proportion of fatty acids in the lipid composition, especially for oleic (C18:1) and linoleic (C18:2) acids. Overlapping similarities and differences in lipid composition did allow differentiation between species studied.

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1. Introduction

Vegetable oils have been investigated principally as alternatives to renewable energy programs and as replacements for petroleum derivatives. These oils are of interest as they can provide decentralized production, possibly resulting in better quality of life in poor regions, allow regional potentials to be reached and offer alternatives to current social, environmental and economic challenges (Martin et al., 2010).

Jatropha curcas (Abedin et al., 2014) is among the emerging species of the genus *Jatropha* whose vegetable oil has potential in terms of bioenergy production (Huerga et al., 2014), since its oil content in the seeds ranges from 33 to 38% of its dry mass (Heller, 1996). There are few scientific reports regarding the potential of

Jatropha mollissima (Auvin-Guette et al., 1999) and *Jatropha gossypifolia* (Felix-Silva et al., 2014). The main characteristics of these oilseeds are that they are species of perennial, shrubby plants that are easily cultivated and not edible due to the presence of toxic compounds such as curcina (Pradhan et al., 2012), phorbol esters (Guedes et al., 2014) and allergens (Maciel et al., 2009).

Regarding the oil quality of the genre *Jatropha*, few studies have been performed related to the fatty acid composition among its species. According to the literature (Azam et al., 2005; Rodríguez et al., 2011), the oil corresponding to the *J. curcas* is made up of the following fatty acids: myristic (14:0), palmitic (16:0), stearic (18:0), oleic (18:1) and linoleic (18:2). On the other hand, for species of *J. mollissima* and *J. gossypifolia*. There are no reports in the literature that would allow comparison based on the fatty acid profiles, despite the phytochemical potential of some of these species having been previously reported (Sabandar et al., 2013).

Thus, the purpose of this study was to evaluate the lipidic profile of the vegetable oil of the seeds: *J. curcas*, *J. mollissima* and *J.*

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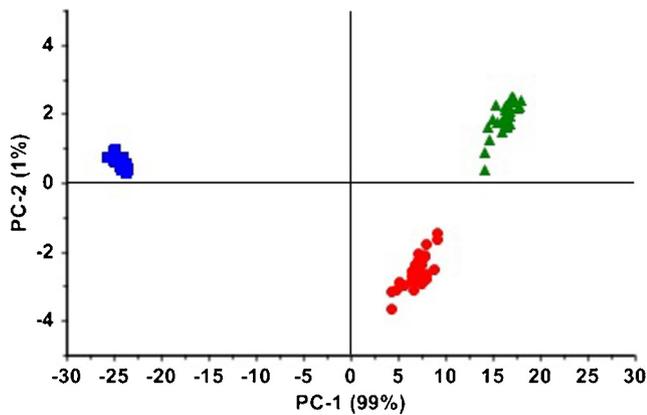


Fig. 1. Score representation with 100% of variance explained for PC1 (99%) and PC2 for *J. curcas*, (\blacksquare), *J. mollissima* (\bullet) and *J. gossypifolia* (\blacktriangle).

gossypifolia in order to obtain a standard of discrimination for the vegetable oil of these species.

the graph presents the scores of PC1 (99%) \times PC2 (1%) for the samples of three species from the *Jatropha* genus, using the decomposing values from Table 1. PC1 takes the *J. curcas*, apart from the others and PC2 separates the species *J. mollissima* and the *J. gossypifolia*. The difference between them is due to the proportion of fatty acids in the lipid composition of each species, remarking oleic (C18:1) an linoleic (C18:2) acids, represented in the loading graph in Fig. 2, as numbers four and six, respectively.

Fig. 3

2. Material and methods

The seed oil extraction of the species *Jatropha* was performed in a Soxhlet system using hexane P.A. as the extraction solvent, intermittently for 4.0 h, in batches containing 5.0 g of seeds that had been previously crushed in an analytic mill. The residual solvent in the oil was evaporated in a thermostated bath, at a temperature of 90 °C. For the transesterification it was necessary to use a condenser bottle in which 300.0 mg of the vegetable oil was added to 5.0 ml of transesterification solution and mixed together, this was subsequently left in reflux for 3 min (Hartman and Lago, 1973). The obtained mixture was transferred to a separating funnel, using 25.0 ml of hexane and 50.0 ml of water and rested for 5.0 min in order to acquire a better separation of the phases, the aqueous layer was discarded. The hexane layer was washed three times with 25.0 ml of water and the

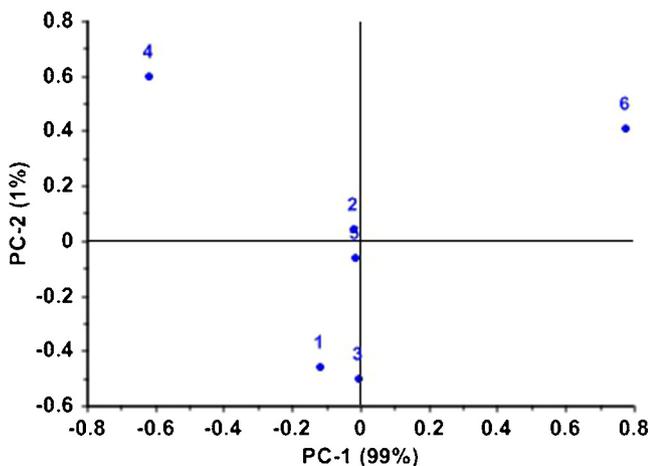


Fig. 2. Loading representation in relation to variants of fatty acids from *Jatropha*, (1) palmitic, (2) palmitic-oleic, (3) stearic, (4) oleic, (5) *cis*-vaccenic, (6) linoleic.

Table 1
Fatty acid composition and oil content in different *Jatropha* species.

Fatty acids	<i>J. curcas</i> (%, w/w)	<i>J. mollissima</i> (%, w/w)	<i>J. gossypifolia</i> (%, w/w)
Palmitic (C16:0)	13.0–16.0	10.0–13.0	8.0–9.0
Palmitoleic (C16:1)	0.7–0.8	0.5–0.6	0.6–0.9
Stearic (C18:0)	6.0–8.0	7.0–9.0	5.0–6.0
Oleic (C18:1)	38.0–40.0	17.0–19.0	14.0–15.0
<i>cis</i> -Vaccenic (<i>cis</i> C18:1)	1.0–1.3	0.9–1.2	0.6–0.7
Linoleic (C18:2)	37.0–38.0	58.0–63.0	68.0–72.0
Oil content	34.1–35.8	17.1–19.4	20.5–23.6

solvent was evaporated in nitrogen flux. The samples of transesterified oils were injected in gas chromatograph (Agilent type 7890A) through an automatic injection system split type injection (1:100), with the use of a HP-88 (60 m/0.25 mm ID/0.2 μ m) column, which uses the FID type detecting system. The carrier gas was helium, at 1 ml/min (constant flow) and the chromatographic run time for each sample was around 60 min. The oven was operated with an initial temperature of 140 °C and a final of 240 °C with a ramp of 4 °C/min, the injector and detector temperature was 260 °C. The fatty acid compositions of the different species were determined by comparing the retention times with a 37 component fatty acid methyl esters (FAME) standard (Sigma code 47168-U).

The matrix data went through a PCA and HCA in order to verify the discrimination according to the formation of the sample group from the fatty acid vegetable oil profile. For the PCA, a method of total cross validation (leaving one out) was used. The HCA dendrogram was developed in the complete linking mode using the co-relation of 1-Pearson R. The sample set consisted of oil coming from three different *Jatropha* genus species, totaling 99 samples, with 11 samples being in triplicate for *J. curcas*, *J. mollissima* and *J. gossypifolia*. The Unscramble X.2 and Statistic 10 softwares were used in the statistical analyses.

3. Results and discussion

Table 1 shows the details of the main fatty acids and their compositing rate, obtained through gas chromatography, as well as the oil content in the three species of the *Jatropha* genus that were investigated in this study, the highlights being the oleic (C18:1) and linoleic (C18:2) acids that together comprised over 76.5%. The mean oil content was 35.0%, 22.1% and 18.3% (w, w) for *J. curcas*, *J. mollissima* and *J. gossypifolia*, respectively.

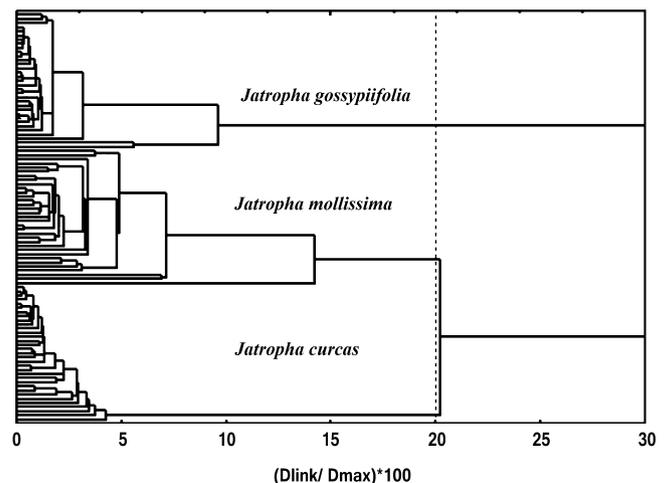


Fig. 3. Dendrogram for vegetable oil of *J. curcas*, *J. mollissima* and *J. gossypifolia* due to the composition of fatty acids.

In Fig. 1 shows the dendrogram for the fatty acid profile of the samples of main species of *J. curcas*, *J. mollissima* and *J. gossypifolia* based on the HCA technique. The dendrogram presented was built using a co-relation of 1-Pearson R with 99 oil samples which determined the proportion in which the two variants were placed between themselves by the closest neighbor. In the linking distance of 20%, the formation of three distinct groups were observed along discriminating the samples of *J. curcas*, *J. mollissima* and *J. gossypifolia*.

The results of fatty acids and oil content in *J. curcas* (Table 1) are similar to those disclosed in the literature (Rodríguez et al., 2011; Rodrigues et al., 2015). Earlier reports were not found for *J. mollissima* and *J. gossypifolia*, which are non-breeding species adapted to semiarid environments. The oil content was lower for these species (18.3–22.1%) compared with *J. curcas* (35.0%), but remarkable differences were found in unsaturated fatty acids composition, with special regard to oleic and linoleic relative proportion. This study represents the first time that results from *J. mollissima* and *J. gossypifolia* oil composition have been disclosed and compared with the oil of *J. curcas*.

4. Conclusions

The fatty acid profile of *J. curcas*, *J. mollissima* and *J. gossypifolia* oil content and both the PCA and HCA techniques can be used as criteria for discriminating the oils from these species. The main fatty acid profile characteristic of the three species is the proportion of oleic (C18:1) and linoleic (C18:2) fatty acids, especially for *J. gossypifolia*.

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