Short communication

Characterization of the cake obtained from pressing the Jatropha curcas *fruit*

Rosa M. Rodríguez-Calle[1], J. Suárez-Hernández[1]
y Yanet Támbara-Hernández[2]

[1]*Estación Experimental de Pastos y Forrajes Indio Hatuey*
Universidad de Matanzas. Ministerio de Educación Superior
Central España Republicana CP 44280, Matanzas, Cuba
[2]*Centro de Ingeniería Genética y Biotecnología, La Lisa, La Habana, Cuba*
E-mail: rosa.maria@ihatuey.cu

ABSTRACT: *Jatropha curcas* has a remarkable potential, which lies on its high oil content for biodiesel production. A study was conducted in order to determine some chemical indicators of the cake obtained from pressing the fruit of this oil plant. The following values were obtained: moisture: 3,80 %; ash: 7,02 %; content of water extracts: 10,7 %; content of ethanol extracts: 6,3 %, which indicated that the quantity of soluble compounds in polar solvents was high. The average value of Klason lignin was 6,32 %. The cake was composed by 51,9 % of carbohydrates (glucans represented 31,7 %) and 32,2 % of crude protein. It is concluded that the *J. curcas* cake, previously detoxified, becomes an alternative for its use in animal feeding.

Keywords: animal feeding, biodiesel, carbohydrates, proteins

INTRODUCTION

The depletion of fossil fuels has led to conduct studies to obtain alternative energy sources, in correspondence with the conditions of each country. Different plant varieties have been studied with satisfactory yields, such as castor oil (*Ricinus communis* L.), sunflower (*Helianthus annuus* L.), African oil palm (*Elaeis guineensis* Jacq.), soybean (*Glycine max*), rapeseed (*Brassica napus* L.), corn (*Zea mays*), cotton (*Gossypium herbaceum*) and physic nut (*Jatropha curcas*), according to Singh *et al*. (2008).

J. curcas is a native tree from Mexico and Central America, but it is found in other countries of Latin America, Asia and Africa (Liu *et al*., 2007). In Cuba it is present in almost all provinces. The exploitation of this plant is extended every day with higher force in India, China, Brazil, Guatemala and in some African countries, which are working to improve the cultivation techniques and the industrial processing of its biomass and/or residue. It is a multipurpose species, with many attributes and considerable potential.

This plant can be an excellent alternative for farmers in the reforestation of eroded zones which are found in regions where their crops have lost their commercial value, and it can be even used as an alternative species. The oil from its seeds has nutritional and culinary uses, and it has also been incorporated in the production of cosmetics and soap.

The resulting cake from pressing the *J. curcas* fruit is a byproduct obtained from the seed once the oil is extracted, which has little commercial value mainly due to the presence of toxic (phorbol and curcin esters) and antinutritional compounds (trypsin inhibitors, phytic acid and curcin). It has been evaluated as substratum for biogas production (Ali *et al*., 2010; Raheman and Mondal, 2012) and cellulosic ethanol (Ncube *et al*., 2012), and as biofertilizer (Raheman and Mondal, 2012) and fungicide (Saetae and Suntornsuk, 2011). The cake derived from the oil extraction has a high potential to complement and substitute the soybean meal (Belewu and Sam, 2010). Once detoxified, it can be used as animal feed, for its high protein content and quality (Makkar *et al*., 1998; Abou-Arab and Abu-Salem, 2010; Aguirre, 2011; Saetae and Suntornsuk, 2011).

The objective of this study was to make a chemical characterization of the cake obtained from pressing the *J. curcas* fruit.

MATERIALS AND METHODS

The study was conducted at the Pastures and Forages Research Station Indio Hatuey (EEPF IH) located in a zone near the España Republicana community, Perico municipality, Matanzas province; at the geographical point determined by 22º 48' and 7'' North latitude and 81º and 2' West longitude, at 19,01 masl (Academia de Ciencias de Cuba, 1989).

Obtainment and characterization of the raw material

The cake came from a previous oil extraction process, carried out mechanically at a temperature of 60 ºC, for which a hydraulic press with adaptation of a vacuum system was used. Five cake samples were analyzed, with a weight of 1 kg each, which were ground through a sieve whose diameter was 2 µm, in order to achieve a more uniform particle size. Afterwards, they were preserved in nylon bags at a temperature of -20 ºC until its later use.

The following indicators were determined: dry matter and ash content, water and ethanol extracts, Klason lignin (as the residue of the analytical acid hydrolysis of the biomass) and carbohydrates (high resolution liquid chromatography) according to the techniques described by the AOAC International (2000). In addition, the crude protein content was determined through the Kjeldahl method (Gaviria and Bernal, 1995).

RESULTS AND DISCUSSION

The residual cake had 3,8 % of moisture, which represents the water content of the sample. This is due to the accumulation of dry matter (mostly oil and protein) in the seed during its maturation. In studies conducted in *J. curcas* seeds from Paraguay and Argentina, significantly different moisture contents were found (6,50 ± 0,10 and 7,20 ± 0,10, respectively), according to Montes *et al*. (2011).

The average ash value of the residual cake was 7,02 %, which provides an approximation of its mineral content. This result coincides with the ones obtained by Saetae and Suntornsuk (2010), Saetae and Suntornsuk (2011) and Saetae *et al*. (2011), who obtained around 8 % of ash in the resulting *J. curcas* cake from the oil extraction. On the other hand, Makkar *et al*. (1998) and Martínez-Herrera *et al*. (2006) found a range of 4,4-4,8 % of ash.

The content of water and ethanol extracts was 10,65 % and 6,32 %, respectively, which indicates that the quantity of soluble compounds (proteins, carbohydrates and minerals) in polar solvents was high. All these compounds are highly important from the nutritional point of view, because they are considered the energy fraction of the sample, which contributes the necessary energy for the metabolic processes to occur (Damodaran *et al*., 2010). Regarding the determination of Klason lignin considered the main chemical barrier for digestion of forages (Deschamps, 1999), a value of 6,32 % was obtained, comparable to 6,1 % of rice straw, a harvest residue highly used in livestock production (Gellerstedt and Henriksson, 2008).

In this study a high value of carbohydrates was obtained (51,9 %), higher than the reports by Makkar *et al*. (1998) and Peralta-Flores *et al*. (2012) in studies with *J. curcas,* where they obtained 35,0 % and 15,1 % of carbohydrates, respectively. These values are considered acceptable, mainly those of glucans, which represented 31,7 % (table 1), which are necessary for animal development and growth because they intervene directly in the metabolism. The content found in the samples is important, as the quality of animal nutrition largely depends on it, because they are rapidly converted into volatile fatty acids and constitute an immediate energy source for the multiplication of the rumen flora (Robles, 2008).

Table 1. Content of carbohydrates in the cake.

Carbohydrate	Percentage
Glucans	31,7
Xylans	14,3
Galactans	2,9
Arabinans	3,0

The protein content was 32,2 %, much lower than the one referred by Makkar *et al*. (1998) for the residual cake from the Cape Verde *J. curcas* (56,4 % CP) or the Nicaragua *J. curcas* (61,2 % CP); but higher than that reported by Rakshit *et al*. (2008), Mahanta *et al*. (2008), Martínez *et al*. (2010), Saetae and Suntornsuk (2011) and Saetae *et al*. (2011), which oscillated between 23 and 28 %.

They are also higher than the ones found by Flores and Cruz (2010) on the accessions Cape Verde and India Salvadoreña (contents lower than 20,20 % and 21,38 %, respectively) and the ones obtained in Africa (25 %) by Nzikou *et al*. (2009).

Other authors, such as Saetae *et al*. (2011), reported that when this raw material is totally defatted, after the previous oil extraction process, between 53 and 58 % of protein is obtained. In this case, the seed was not separated from the nuclei and the surface oil was not removed from the cake obtained; this could have been the cause of the difference between the obtained value and the reports in literature.

The protein content obtained in this study is high when compared with that of other plant protein sources that are currently used in the food industry.

This lays the ground for the characterization and determination of the functional characteristics of the majority fractions of the proteins in the press cake obtained from the fruit of this species. In addition, according to Phengnuam and Suntornsuk (2013), it is necessary to know the digestibility of aminoacids, which are used as protein source, to make the formulation of the diets according to the requirements of each species.

It is concluded that the cake obtained from pressing the *J. curcas* fruit has a high content of the carbohydrate glucan, essentially important biomolecule for animal development and growth; and an acceptable protein content, for which, previously detoxified, it could become an alternative for its use in animal feeding.

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