

Physico-chemical characterization of the residual cake of D-004 production: lipids extract of the *Roystonea regia* fruits. Technical note

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The physico-chemical characteristics of the residual cake (RC) obtained from the production of the D-004 were determined. The 61.9 % of the cake was formed by particles between 2.36 and 0.5 mm. Its main proximal composition was the following: humidity (8.70 %), crude protein (9.50 %), crude fiber (31.57 %), ash (6.46 %) and fat (0.77 %), mainly composed by the fatty, palmitic, lauric and myristic acids. The total content of polyphenols was 1.53 ± 0.02 mg/100 g. The elemental composition (ppm) included: Ca (3983 ± 48), Na (938 ± 9), Mg (1967 ± 14), K (10492 ± 151), Fe (42.07 ± 0.6), Zn (19.1 ± 0.1), Mn (10.3 ± 0.6), Pb (< 0.5), Co (< 0.5) and Cd (< 0.1). The physico-chemical characteristics of the RC from D-004 production are a source of macro and micronutrients. These preliminary results sustain the development of further studies to determine the possible application of this RC in swine feeding.

Key words: D-004 by-product, palm tree nut, palm tree, chemical composition.

As consequence of extracting plant oils, more than 151 millions of tones of by-products or organic residues are generated worldwide per year (Thoenes 2012). With the purpose of taking advantages of these residues and, thus, avoid the environmental pollution, they are used as bio-fuel, in bio-fertilizers production, as animal feeding and fermentative substrate of several bio-processes (Hakimi *et al.* 2010).

The National Center of Scientific Research (CNIC) produces, at pilot scale, the D-004, a new active pharmaceutical ingredient obtained from the palm tree nut oil (mature entire fruit of *Roystonea regia*). It has demonstrated to diminish the lipidic peroxidation and prevent the prostatic hyperplasia in rodents (Pérez *et al.* 2008). As by-product from obtaining D-004, a residual cake (RC) is generated, representing 85 % of the total palm tree nut defatted. This solid, without fat and dry, is a powder with particle size < 2.36 mm.

At present, the expected increase at large scale of D-004 production will provide higher amounts of RC, which might be a problem for the environment. The objective of this study was the preliminar physico-chemical characterization of the RC from the production of D-004 to be used by other enterprises.

Three lots of at about 200 kg were obtained for conducting the study. Each of them was resulted from mixing homogenously four lots of RC, produced during a year, as consequence of producing D-004 from palm tree nut of the western part of Havana. Out of each lot, three samples of 15 kg were extracted (L-1, L-2 and L-3) through a simple completely randomized design. The samples were placed in plates and sun-dried for three days to assure the total evaporation of the residual solvent. Later, they were stored at 4°C until the corresponding analyses were conducted.

Each sample was determined the bromatological composition, according to the official methods of AOAC (2000) and the total content of polyphenols, in agreement with the method of Suolimani *et al.* (2007). The identification and quantification of the fatty acids of the RC fat was conducted by gas chromatography and gas chromatography coupled to a selective mass detector, according to an adaptation of the 108,003 method from the Institute for Nutraceutical Advancement (INA 2011). The minerals composition was determined by spectroscopy of atomic absorption and flame photometry, according to methods of the United States Pharmacopeia (USP 33, 2010). The distribution of the particles size was carried out with a set of sieves between 2.36 and 0.25 mm. The percentage remaining in each sieve was determined with the following equation:

$$\text{Percentage remaining in the sieve} = Ri * 100 / M1$$

Where:

Ri is the mass (g) of the content remaining in each sieve

M1 is the mass (g) of the sample

Each analysis was carried out by triplicate and the position and dispersion statigraphs were calculated (mean, standard deviation and coefficient of variation) with the software STATISTICA 8.0 for Windows (StatSoft Inc. 2006). A general mean was obtained from those of each lot's samples to determine the physico-chemical characteristics of the RC.

The table 1 shows the results of the mean bromatological composition of the three lots of RC. As it can be seen, the mean contents are very similar, with standard deviations (SD) below 2. The proved low residual humidity should impede the microbial prolificacy, while the general mean content of the RC CP (9.51 %) was higher, compared with the contents

determined by Macías *et al.* (2010) in the palm tree nut (7.68 %). This last result was expected, as the RC is the product obtained after defatting the palm tree nut. During this process, the fruit losses more than 15 % of its mass, with the respective proportion increase of the rest of the nutrients (Rodríguez *et al.* 2011).

The general mean content of CF (31.59 %) was inferior to that reported by Macías *et al.* (2010) (35.80 %). This could be due to variations of the method and plant materials used. An efficient fat removal from the fruits was evidenced during the obtainment of D-004. The carbohydrates (calculated by difference of results normalization at 100%) were the main constituents of the RC, with general mean of 41.82 %.

The determination of fatty acids (FA) composition of the lipid material obtained from the RC showed low content of unsaturated FA (< 1 %). However, in the fruits oil, a content of these acids superior to 50 % have been found (Rodríguez *et al.* 2011). This difference could be due to a higher solubility of the unsaturated acilglycerides in the extraction dissolvent with which the ground palm tree nut was defatted. In this sense, the major FAs were those saturated: palmitic (51.15 %), lauric (30.31 %), myristic (12.36 %) and stearic (4.29 %).

The mean mineral contents (ppm) of the RC lots are presented in table 2. The Ca, Na, K and Mg were the most abundant minerals, turning the RC into a rich source in these minerals. The distribution of the particles size showed that 61.9 % of the cake was formed by particles between 2.36 and 0.5 mm. Particles between 0.5 and 0.25 mm corresponded to the 35.8 % and

2.3 % of the particles measured less than 0.25 mm. Finally, the total content of polyphenols was relatively low (1.53 ± 0.02 mg/100 g of RC).

It is concluded that the physico-chemical composition of the RC from the production of D-004 is a source of macro and micronutrients. From the results of this study and considering that the palm tree nut has been traditionally used in Cuba as pigs feeding (Ly *et al.* 2011), new studies about the possible inclusion of this RC in the diets of these animals are suggested, as a way to confirm the use of RC in the swine feeding.

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Table 1. Mean bromatological composition (%) of three lots of RC

	L-1	L-2	L-3	Mean	SD	VC (%)
Humidity (%)	8.50	7.10	10.50	8.70	1.71	19.64
Fat (%)	0.74	0.79	0.79	0.77	0.03	3.60
CF (%)	31.69	31.78	31.31	31.59	0.25	0.79
CP (%)	9.49	9.53	9.50	9.51	0.02	0.24
Ash (%)	6.27	6.66	6.45	6.46	0.17	2.63
Carbohydrates (%)	41.97	42.41	41.07	41.82	0.68	1.63

Table 2. Mean elemental composition of three lots of the RC (ppm)

Element	L-1 (ppm)	L-2 (ppm)	L-3 (ppm)	Mean (ppm)	SD	VC (%)
Ca	3996.0	4062.0	3892.0	3983.33	85.70	2.15
Na	930.0	948.0	938.0	938.67	9.02	0.96
K	10473.0	10700.0	10304.0	10492.33	198.71	1.89
Mg	1951.0	1998.0	1953.0	1967.33	26.58	1.35
Zn	19.4	19.1	18.7	19.07	0.35	1.84
Mn	10.4	10.2	10.31	10.30	0.10	0.97
Fe	42.8	41.6	41.8	42.07	0.64	1.53
Pb	< 0.5	< 0.5	< 0.5	<0.5	-	-
Cd	< 0.1	< 0.1	< 0.1	<0.1	-	-
Co	< 0.5	< 0.5	< 0.5	<0.5	-	-

Cuban Journal of Agricultural Science, Volume 47, Number 4, 2013.

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Received: July 13, 2013